ACC NO. 5510

OCONUT PLANTER'S MANUAL

OR

All About "The COCONUT PALM"

(*Cocos Nucifera,*)

INCLUDING

PRACTICAL INSTRUCTIONS

FOR

LANTING and CULTIVATION

WITH

Estimates Specially Prepared for Expenditure and Receipts.

SPECIAL CHAPTER ON DESICCATING COCONUT

ND OTHER SUITABLE INFORMATION FROM A VARIETY OF SOURCES; REFERRING TO THE INDUSTRY IN CEYLON, SOUTH INDIA, THE STRAITS SETTLEMENTS, QUEENSLAND AND THE WEST INDIES.

COMPILED BY

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Editor of the "*Ceylon Observer*" and "*Tropical Agriculturist.*"

FOURTH EDITION.

Price R3 or 4s. Nett.

COLOMBO, CEYLON. | 52 GRACECHURCH, ST,, LONDON, E. C.

A. M. & J. FERGUSON.

For list of Agents see Advertisement at end.

1907

PREFACE TO THE FOURTH EDITION.

IN publishing a FOURTH EDITION of our MANUAL ON THE COCONUT PALM—first issued in 1885 and revised and reprinted in 1888 and 1904—we give prominence to what is of immediate service to the intending cultivator, and to relegate to an APPENDIX the fuller but less important information compiled from various sources. But we must point out that while practical instruction for the Planter will be found at once on pages 26-57, he must not omit to notice the useful information from practical writers given on pages 57-70; and again ii to xxvii and lxxvi-c. The Estimate of Expenditure and Receipts for a Plantation on pages 71-2 can be compared with another much more detailed on pages 73-75, which is more "up to date." We have as the penultimate chapter of this volume, a final contribution on the subject of Coconut Planting from one who was a patriarch among his brethren in this island, and whose shrewd commonsense was proverbial: we refer to the late Mr. W. B. Lamont, who was for 55 years a planter in Ceylon and died in the island. The late Mr. Jardine and the veteran Mr. W. H. Wright who is still happily with us, Mr. F. Beven, Mr. G. T. Nicholas and other practical living planters among us, are those on whom we have drawn for information as to cultivation, while in respect of enemies and diseases the reports of Messrs. H. N. Ridley, D. Morris, E. E. Green, T. Petch, C. Drieberg and others are given. Finally, we are able to give a chapter on Desiccating Coconut from the pen of Mr. C. M. B. Wilkins.

The varied information respecting Coconut Cultivation in countries other than Ceylon, cannot fail to be useful; and we have specially to thank Mr. H. N. Ridley, Director of Botanic Gardens and Forests, Singapore, for permission to reprint his Report (and illustrations) on the destruction of Coconut Palms by Beetles—see pages lv-lx.

THE COMPILER.

NOVEMBER, 1907.

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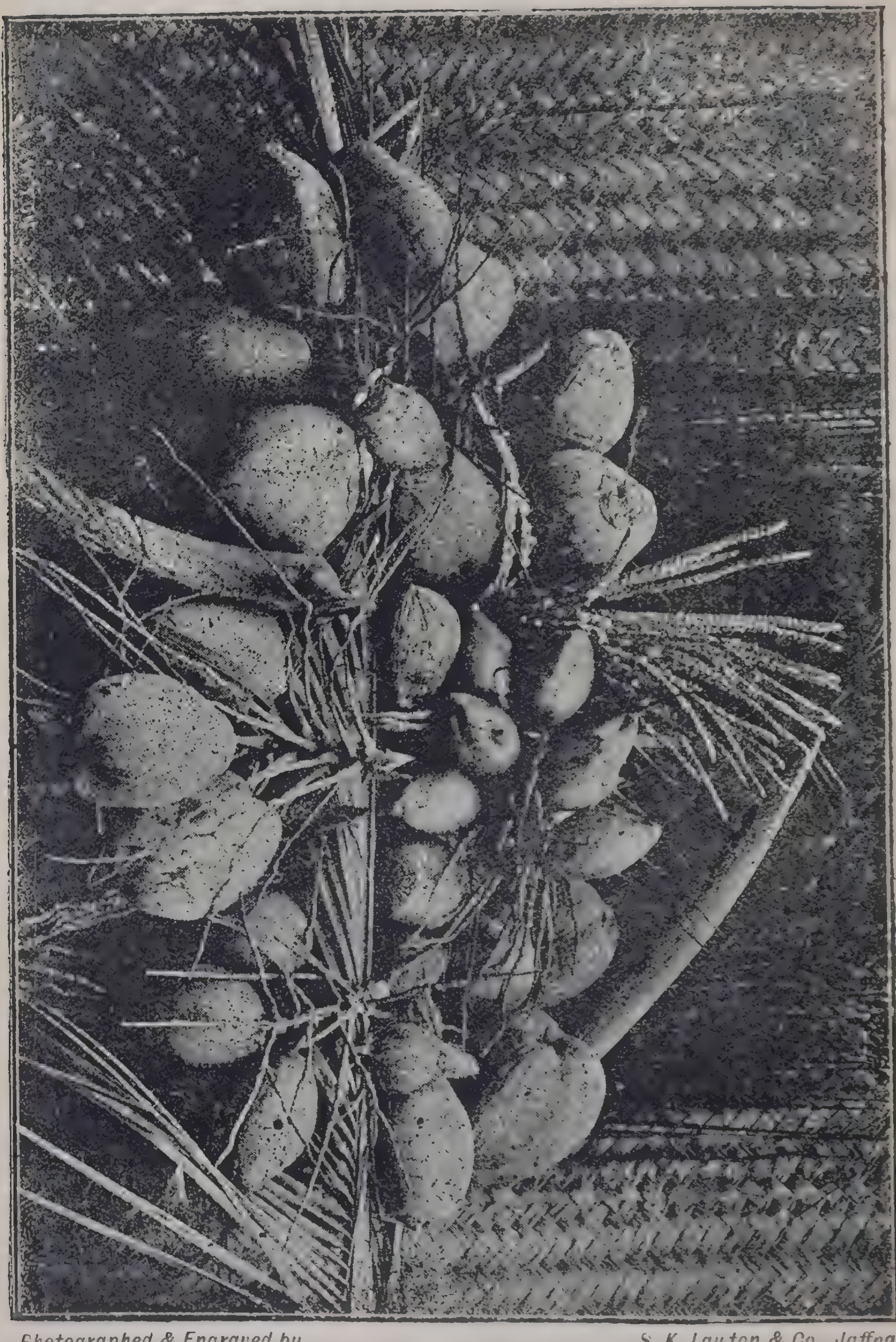

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CLUSTER OF COCONUTS.

COCONUT PLANTER'S MANUAL.

THE BEGINNINGS OF COCONUT CULTIVATION IN CEYLON.

THE coconut palm is by no means indigenous to Ceylon. Though the most striking and ubiquitous of all plants over a great part of the lowcountry, the palm is nowhere found that its planting cannot be accounted for: and unlike the cinnamon bush, or rather tree, it can nowhere be discovered in a wild state.* De Candolle, the greatest authority on the subject, places the original habitat of the coconut palm in the Eastern Archipelago, somewhere in the neighbourhood of Sumatra and Java, and surmises that nuts floated thence both East and West:—Eastwards to the Islands of the Pacific and the Coast of Central America, and Westward to Ceylon and the East Coast of Africa.† The native tradition that locates the earliest specimen or grove of this palm in the neighbourhood of Weligama, on the Southern Coast, is in strict accordance with what might be expected under De Candolle's theory. The tradition is that a king of Ceylon was a leper, or afflicted with some skin disease, and that he (Kusta-Raja) was cured by sea-bathing and the milk of the coconut, or the use of the expressed oil. Curiously enough, the *Mahāwaṇsa* (the ancient Sinhalese history of Ceylon) does not contain nearly so many references to the coconut as it does to the palmyra palm, although the later now does not cover nearly the area occupied by coconut. One shrewd surmise why the *Mahāwaṇsa* has so little to say about the coconut, hazarded by Mr. H. Nevill, is that the practice of toddy-drawing after a time, and its distillation into spirit, would prejudice the priestly historians

* See the Paper entitled:—"The Coconut Palm in Ceylon: Beginning, Rise and Progress of its Cultivation," By Hon. Mr. J. Ferguson, C.M.G.,—Journal No. 57, Vol. XIX, 1906, of the Royal Asiatic Society, Ceylon Branch.

† See what De Candolle says in his book, reproduced in full in the appendix.

against the palm and its cultivation. Be this as it may, Mr. Nevill notices that the *Mahāwaṇsa* (XLII. chapter) records how King Aggrabódhi I. about A.D. 589 caused "a coconut plantation of three yojanas (about 36 English miles) in extent" to be formed, probably between Dondra and Weligama, and so it is surmised that his statue was cut out of the rock near the Weligama Vihara, as a memorial of the King who began a systematic plantation if he did not introduce coconut planting into Ceylon. There are, however, some earlier historical references to the coconut in Ceylon, but there is no need to go further into the question here.

We were indebted for a later link in the chain of local coconut planting to the intelligent Attapattu Mudaliyar of the Colombo Kachcheri. Looking over his English copy of the *Mahāwaṇsa* Mudaliyar Solomon Seneviratne came on the passage where it is related that the Minister of Prákrama Báhu the Great formed a coconut plantation between Bentota and Kalutara, one yojana or 12 English miles in width. The original passage bearing on the planting is worth transcribing as follows:—

"Thence the great minister proceeded to the port of Bhimatittha. And there he built a bridge, eighty-six cubits' span, at the mouth of the Kálanadi* river; one of about one hundred yatthis' † span at the village Kadalisena; ‡ one of forty yatthis' span over the Salagama river § and one of fifty cubits' span over the Salapadapa river.‖ Thus did he build these and other bridges at divers places where it was difficult to cross over; and likewise also he made numerous gardens and halls for preaching and the like, and did even give away much alms and hold feasts (in connection therewith).

"Afterwards this great minister of the king formed a large coconut garden, full of fruit and fine shade, and gave it the famous name of Prákrama Báhu; and it extended from the Bhimatittha Vihara [Bentota] unto the ford of the Kálanadi [Kaluganga], a space of about one yojana in width.

* The Black river, Kalu-ganga.

† A yatthi is equal to seven cubits of two spans to the cubit.

‡ Kehelsen, Kehel-lenava?

§ Salgamu-ganga.

‖ Salruk.

"And when he had caused the great forest Mahalabujagaccha* to be cut down altogether and rooted up, he made a fine village thereon and planted a large grove of jak trees near it."

The Attapattu Mudaliyar, in calling our attention to the passage, writes :—

"It appears that coconut estates on a large scale were planted on the South-Western Coast of Ceylon long before the arrival of the Portuguese. See 44th verse of the 86th chapter. 'Bhima-tittha' is modern Bentota. 'Kalanadi' is the Kaluganga. The whole of the coast line from Kalutara to Bentota formed one coconut garden, and was named after the King who caused it to be planted.

"It is very interesting to find that the Sinhalese of that date had found the best soil in the Island for coconuts to plant the Royal garden. It is possible, as you mentioned to me, that on the Southern part of the coast the coconut first grew from nuts washed ashore from the Eastern Archipelago."

The strange part is, if there were extensive coconut groves in the South-West part of the island before the advent of the Portuguese, that there is little or no mention of the coconut by the Portuguese historian Ribeiro or his French editor. The areka and talipot palms are freely mentioned; but the coconut much less prominently. It is only after the arrival of the Dutch that we hear of a stimulus to the extension of coconut planting being afforded. But even then, it will take most people by surprise to learn that so late as A.D. 1740 the coast line between Colombo and Kalutara—now a continuous coconut grove—remained almost unplanted and was described as "nine-tenths waste," and so Governor Van Imhoff, in that year, proposed surveying and distributing this land in limited portions to "persons who are inclined to plant them with coconuts and to pay Government duties on them." So, it would seem that by a system of "Rajakariya" was most if not all the coconut planting (as also all the tank building and canal digging) done in Ceylon previous to the advent of the British. And yet we have no hesitation in saying that the past 60 to 70 years have seen more than six times the area covered with the coconut palm that can be credited to all the Kings or Governors of Ceylon in the twelve hundred and sixty years between A.D. 589 and 1840.

* Madelgasvanaya.

PALM CULTIVATION IN CEYLON.

There are said to be over a thousand known species of palms, but of these the proportion found in Ceylon is very limited, only 10 to 12 indigenous species, while perhaps 25 to 30 are found in the Botanic Gardens. We have now in Ceylon, however, those of most value for their economic products, pre-eminently the Coconut and Palmyra, the Jaggery or Kitul (*Caryota urens*), the Arecanut, and the Talipot palm. By far the most important to the people of Ceylon is the

Coconut (*Cocos nucifera*)

The coconut is by no means so often mentioned in the *Mahávanso* (the ancient Sinhalese history of Ceylon) as the palmyra, and no allusion whatever is made to it as an article of diet in any of its products, nor is it mentioned among fruit trees desirable of cultivation before 1153. In the same way, although the areca and talipot palms are alluded to by early European writers, there is little or no mention of the coconut, now the most prevalent of all and the mainstay of native agriculture. The Dutch gave a great stimulus to the cultivation of the coconut; for, what is now the scene of one of the most continuous groves of the palm in the island—namely, between Colombo and Kalutara—was so lately as 1740 described as nine-tenths waste. Governor Van Imhoff in that year proposed surveying and distributing this land in limited portions to "persons who are inclined to plant there with coconuts and to pay Government duties on them." The ordinary life of a coconut palm is said to be about 80 years, but there are trees along our western coast certainly over 120 years still bearing, and some coconut planters believe the coconut tree practically has no limit to its productive life if judiciously and librally treated. At the beginning of the present century, the Western and Southern coasts of Ceylon presented, with certain intervals, a fairly continuous grove of coconut palms, but it did not extend far inland (10 million coconut trees being the reckoning between Dondra Head and Kalpitiya), but Bertolacci pointed out the large field for an extension of planting on the North-West coast around Chilaw and Puttalam, and he mentions that the peninsula of Kalpitiya was, in his own time within 18 years, changed from a barren unproductive soil to an expanse of the finest plantations of this palm, and splendid cultivation extends now (1907) all the way from Colombo via Negombo and Chilaw almost

continuously to the neighbourhood of Puttalam. Little or no coconut oil was in the first quarter of this century exported from Ceylon to Europe.* To India between 1806 and 1813 there were annually sent about three millions of coconuts, 28,000 measures of oil, and 3,500 cwt. of copra, besides 20,000 cwt. of coir. The Arabs must have taught the Sinhalese how to prepare coir or cordage from the fibre of the coconut about the 13th or 14th century. The manufacture of coir (said to be best from unripe nuts) from the husk of the coconut acquired great importance in the time of the Dutch, as many as 3 million pounds—of cordage, chiefly—being supplied and exported principally to Batavia and the Cape of Good Hope. The port captains of Colombo and Galle were allowed to manufacture or sell on their own account; the former 600,000 lb. and the latter 500,000 lb. of coir cordage. In the early days of the British the manufacture fell off, the natives considering the work only fit for low castes; but at the present day it affords extensive employment to the inhabitants on the coast, especially in the South and West.

Systematic coco-palm cultivation by Colonists in Ceylon was first commenced in the Jaffna and Batticaloa† districts in 1841, and a vast amount of money has been lost over it from first to last, many of the plantations having passed out of the original proprietors' hand for a trifling percentage of their cost. In 1853, Mr. A. O. Brodie Assistant Agent at Puttalam, stated that there were nearly a million coconut trees in the district of Chilaw and Puttalam, and that the

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* In 1820 Captain Boyd, an Aberdeen navigator, in command of an East Indian trader (the partner afterwards in the firm of Acland, Boyd & Co.), is said to have taken home the first cargo of coconut oil ever exported from Ceylon. There was, at that time, no market for this article in England, and when the cargo arrived home there was some difficulty in persuading any one to purchase it. At length some relatives of the captain, proprietors of a wool mill, reported on the fitness of the oil for lubricating purposes, and a sale was effected. In 1832 or 1833 Acland, Boyd & Co. established the first oil mill worked by steam, and the export trade in coconut oil then became a favourite mode of utilising the savings of civilians and military men. Master Attendant, then Capt., Steuart also took a cargo of coconut oil home about 1820, utilising plantain stems to fill up the interstices between the casks. Another account has it that Governor Sir R. Wilmot Horton established the first coconut-oil mills worked by steam power at Colombo and made the first shipment of oil on Government account to London and that Messrs. Acland, Boyd & Co. then bought the mills (St. Sebastian) and got out an engineer of their own, the late Mr. Rudd, Senr. In the Government Calendar for 1835, one entry in the Directory portion for Colombo is:—"The Steam Engine in the charge of Mr. H. Rudd." Some years after Messrs. Wilson & Archer started the Belmont (now Hultsdorf) mills, Mr. David Wilson's father having invented a process for separating the fat from the oleine of the coconut oil, so making it (cocount oil) to keep liquid in cold: this gave a great impetus to the trade

† See *T. A.* vol. 1893-4 page 343.

cultivation was rapidly extending. From 1840 to 1850 was the era of planting by Europeans; then came a blank of ten years, and then the natives began to extend their cultivation, and in the Western and N.-W. Provinces especially, they brought many thousands of acres of jungle under cultivation, more especially along the valley of the Mahaoya between Negombo* and Polgahawela, beginning with 1860, and of later years in the Chilaw and Madampe districts of the North-Western Province; at Rajakadaluwa and beyond towards Puttalam the process of planting cocouuts still goes on, and there are large reserves. This movement forty to fifty years ago was a consequence of the growing prosperity of the people through the money disseminated for rice and other supplies, for carting, artificers' work, &c., by the great coffee enterprise from 1850 onwards, and of the Government unlocking their low-country reserves of Crown land. The latest extensive development has been in South Batticaloa district (Akkarapattu & Padruppu, south of Kalmunai) where several thousand acres have been planted within the past ten to fifteen years.

The principal coconut-growing region in Ceylon extends in a belt along the North-Western, Western and Southern coasts of Ceylon, and in the Batticaloa districts of the Eastern Province and the Jaffna Peninsula in the North. Of late years a great deal of land has been planted more inland in the Western and North-Western Provinces, more especially along the side of the railway linc, where Government have sold extensive areas for this purpose, and as stated above throughout the Mahaoya valley, in the Kegalla and Kurunegala districts, &c. The coconut palm flourishes in the neighbourhood of Ratnapura and there ought to be considerable scope for further planting in the Sabaragamuwa district, only that it is generally too wet to allow of liberal fruit crops. Some of the Kelani Valley tea planters tried interplanting coconuts in their fields, one Veyangoda estate alone supplying 32,000 nuts, enough for nearly 1,000 acres of plants widely interspersed; but in some cases these have been supplanted by the latest favourite, the Para (Hevea) rubber plant. The popular belief is that the coconut tpalm will not do well beyond the sound of the see waves or the human voice, but, on the contrary, very fina groves are found in the Central Province, in the rich valley of

* The several industries in the products of the palm have developed in a remarkable way. There are now in the district at least two Oil-Mills with hydraulic machinery driven by steam power, besides a number of *chekoos* worked by cattle and hand, two desiccating factories and six or seven Coir Fibre mills.—*H. White, Negombo Administration Report for 1893.*

Dumbara, around Gampola, Peradeniya, Kandy, and in Matale, and in certain years, considerable crops, up to some millions of nuts have been returned as the annual harvest in the Central (15,000 acres giving 22 millions nuts one year) and Uva provinces. The latter grew over 5 million nuts in one year. The coconut palm requires an average temperature of 80 degrees, and 70 inches annual rainfall, although in the Chilaw district it does with less : the best soil is on the alluvial flats alongside large streams not too frequently or long flooded; secondly, a deep brown gravelly loam such as the Matale Valley has in perfection in many parts. At Badulla there is a good coconut garden flourishing at 2,000 feet elevation; and coconut-planting goes on at Bibile and Medegama. On one estate in the Matale district' 90 acres coconut with coffee interspersed did excellently well for some years, and the palms are still flourshing. In Ambagamuwa there is a solitary coconut palm at 3,500 feet above sea-level, but it has never produced fruit. Of late years a great many coconut palms have been planted in coffee and cacao land in the Dumbara Valley, Kelani Valley, and Kegalla generally, (perhaps 30,000 acres altogether) Galagedara, Panwilla, and Matale districts; aud very large plantations opened in the Kurunegala district. Coconut planting has also been greatly extending in the Batticaloa district, more especially in the new Southern district of Akrapattu where 3,000 acres have been sold and 2,000 brought into cultivation; while 875 acres have been planted in Trincomalee district; in Puttalam, 14,000 acres planted in 14 years; in Chilaw, Pitigal Korale South having 65,000 acres under coconuts. Even in the North-Central Province a good deal of planting has been done in recent years, and Mr. Ievers estimated in 1888 that 1,500 acres were under the palm. We fear 500 acres more have not been added in the past 18 years. In Jaffna 300 acres were planted in 1900 and the railway extension to that peninsula should stimulate further planting. Mullaittivu district has 1,351 acres under coconuts yielding nearly 5 million nuts in one year.

The calculation up to 1860, was that there were 250,000 acres of coconut palms (belonging to native and European-owned plantations) in Ceylon, covered with twenty million full-grown trees; but considering the extension or planting chiefly by natives in the interval of 33 years, we raised the total in 1893 to 650,000 acres; but now in 1907 we feel bound to revise this and give (in view of our calculations on another page) the total area at 750,000 acres with 60 million trees,

or three times the area and number given 47 years ago. In our Directory only 250,000 acres are entered of regular coconut plantations. Natives own 50,000 acres at least besides out of a total of 750,000 acres. There is scarcely a native land-owner or cultivator in the country who does not own a garden of palms, or other fruit trees, or vegetables besides his paddy-field. Our estimate is far below the figures given in the Government Blue Book for 1906 which, however, we feel sure, are ridiculously inaccurate, as regards acreage and crops in certain provinces. Here is a summary of that return :—

AREA AND CROP OF COCONUTS IN 1906.

Province.	*Acres.*	*No. of nuts yielded.*	*Average per acre.**	*No. of coconut trees at 80 to acre.**
Western	325,522	372,126,975	1,143	26,041,760
Central	17,531	16,847,291	961	1,402,480
Northern	22,239	25,414,932	1,143	1,779,120
Southern	104,517	252,144,250	2,412	8,361,360
Eastern	34,539	50,125,100	1,451	2,763,120
North-Western	445,352	773,443,032	1,737	35,628,160
North-Central	2,223	1,834,000	825	177,840
Uva	4,331	18,754,429	4,330	346,480
Sabaragamuwa	40,776	73,584,800	1,804	3,262,080
Total	997,030	1,584,274,809	1,589	79,762,400

The total acreage and number of trees in the North-Western Province and the total yield given of nuts are far too large ; but it is when the extent in all the provinces is noted that the unreliableness of the figures is exposed : an average yield of 1,260 nuts per acre for the island is about what used to be the minimum estimate or say at most 1,400 nuts. For, while on plantations the crop is sometimes up to 4,000 per acre, on the other hand, gardens not cultivated give less than half and much of the native land is covered with worn-out or over-crowded trees bearing nothing. We cannot, however, accept more than 60 millions as an approximate estimate of the number of coco-palms of all ages from those newly planted upwards, and we would reduce the acreage to 750,000 acres. We believe, further, that the number of coconuts produced in a good average season in Ceylon cannot well reach beyond 1200 millions the greater portion being used for the food and drink of the people.

It requires about 40 full-grown nuts or a full year's crop from an average good tree on a plantation to make 1 gallon of oil, 12½ of which (say 500 nuts) go to a cwt. worth up to R30. Copra requires from 170 to 200 nuts to the cwt. Desiccated coconut kernel for confectionery—

* The Compiler is responsible for figures in these columns.

3 nuts to 1 lb.—is a recent local manufacture of growing importance, (see our list of Mills* for its preparation and the large export now over 20 million lb., per annum); and coconut butter has become a great industry in Germany. For 1,200,000 gallons of arrack consumed annually in Ceylon and 120,000 exported, 330,000 palm trees at 4 gallons per tree may suffice (Mr. Ellis got 5·94 gallons from some rich trees); but an enormous number of palms are devoted to sweet and even intoxicating toddy. Taking last year's (1906) return of Exports we work out trees as follows:—

Coconut oil	539,070 cwt.	= Nuts	270,000,000
Copra	451,134† ,,	= ,,	90,000,000
Desiccated	20,213,570 lb.	= ,,	60,000,000
Coconuts	No.	= ,,	16,013,500
(Poonac and Coir are got from Oil and Copra nuts)			
Arrack, and Baker's and Sweet Toddy, say		,,	1,800,000
		Total Nuts...	437,813,510

or not nearly one-half of the coconut crop from Ceylon palms, apart from the trees not in bearing or past bearing. If we take 15 millions (chiefly on plantations) as yielding the above, 36 for local food, ‡ and 9 for young and old palms, we get a total of 60 million Coconut palms of all ages and qualities in Ceylon.‡ [For discussions as to superior value of Cochin oil, see *T. A.* page 597 vol. 1897-98. For proper spelling "Coconut" see *T. A.* page 473 vol. 1895-6.]

We quote as follows from a letter of "W. B. L." in December 1887:—

"I do not know the proportion of oil obtained from copra in the great manufactories: but I wrought chekkus for a dozen years, and always got three gallons of oil from 45 lb. At 9 lb. 3 oz. to the gallon this is 27 lb. 9 oz. or 61·8 per cent. I cannot believe that the chekku can extract more oil from the same copra than the hydraulic press, from thoroughly ground material: but the chekku will only operate satisfactorily on copra as dry as sun or fire heat can make it. If then a recent statement as to the outturn of the mills be correct, it

* In Ferguson's "Ceylon Handbook and Directory" for 1907-8.

† In 1898 the export of copra was as much as 506,277 cwt. Highest price of copra was £33 10s. per ton, London price, May-June 1902. Highest price in 1907, was £27 17s 6d per ton on 11th March.

‡ Say that there are 800,000 families in Ceylon, do they use two coconuts at least a day on an average? Let us take two and we get 730,000,000 nuts requiring about 36 million trees as above (native palms yield only half what plantation trees do) and giving a total of 60 million trees. In the Laccadives, each adult is said to eat four coconuts a day. See also page 777 (*et seq.*) *T. A.* 1892-3.

indicates the average of superfluous moisture in commercial copra to be 8·5 per cent. supposing the chekku and mill machinery to be equally effective."

The Government Bluebook for 1906 reports 2,016 oil mills in the Island—native "chekkus" driven by bullocks, chiefly—divided as follows:—Western Province 816; North-Western 174; Southern 849; Eastern 34;* Northern 143; Central and North Central and Uva 0; Sabaragamuwa 0. But the chief work in expressing oil is done in the great steam mills (6 reported) with hydraulic machinery at Colombo:—Hultsdorf, Grandpass, Kelaniganga, Mattakkuliya, Hunupitiya, Mills, &c., and at Negombo. Of Desiccating Mills there are 9 in the Western and 2 in the N.-W. Province. Coir fibre, yarn and mattings are also prepared at some of the mills, notably at Hultsdorf, Dematagoda, Grandpass, Lunuvilla, Mirigama and Veyangoda.

To a Ceylonese coconut plantation proprietor belongs the credit of introducing irrigation for the cocount palm on an extensive scale as a full account given in the *T. A.* vol. 1887-8, page 687 will show.

Of the earliest age at which the coconut palm can be brought into bearing under favourable circumstances in Ceylon, we have the following evidence from a practical planter:—"Of 200 plants I put down in May 1879, ten per cent are now (June 1886) in flower, and I have already gathered nuts from the most forward tree. It appears

* In the Administration Report of the Government Agent for the Eastern Province for 1890 we read:—"Coconuts continue to be an important factor in the food supply, not only as being directly consumed in large numbers, but on account of the additions to the pecuniary resources derived from the sale of surplus, chiefly in the shape of copperah. The demand for land continues entirely in small blocks, by natives especially on the North road. The crops of manioc, yams, and vegetables taken off the land after it is first cleared, and for two or three years after, are also a material addition to the food supply, especially in such a year as we have just passed through. Mr. E. N. Atherton has favoured me with the following account of the application of European enterprise and capital to coconut cultivation in this district:—'Dr. Sortain was the first to open his coconut estate, Tannamurai, five miles from town, bordering the lake, in 1846. Simultaneously my father opened Kalmunai estate, opposite the obelisk, and subsequently sold it to his cousin, Meadows Taylor, the novelist, whose brothers, Selby and Granville Taylor, opened Linsogoor and Hyderabad estates, the former for Gerald Balmain and the latter for their brother. Holderness opened Easter Seatoun for Ouchterlony in 1847, I think, after which Cumming and Drummond opened Tuvaringe, Springfield, and Kaluthavala estates. Mylempavelli, on the 7th milepost, was opened by Doctor Galland. Santhivelly, Munro's, was opened by him in 184[illegible] and Rockwood by Kidd in 1850. O'Grady opened his present estates for Nicol, who was so disgusted that he sold them cheap to the former.'" For 1897, the A. G. reports over 2,000 acres sold for coconuts and 6,000 acres at Tirukovil to be disposed of in April 1898; altogether 30,000 acres suitable for coconuts have been surveyed. About 2,000 acres have been opened at Tirukovil.

then, that, though coconuts are not suited to the views of those who think to make rapid fortunes, there is no undertaking in the colony, where so much can be got, for so little outlay, by those who have the patience to *wait*, and there is nothing so suitable for such of the people of the country as have a little capital to invest if they will only do it justice during its early years."* In the Rajakadaluwa district, estates in their 9th and 10th year have yielded over 1,200 nuts per acre. The use of Salt would be very beneficial to Coconut culture : see page 256, vol. *T. A.* 1897-8.

Of the self-propagating power of the coconut, we had an interesting report in *Nature* (1890) from a traveller who found young coconuts growing on the margin of an out-of-the way South Pacific island, and naturally concluded that they were nuts carried thither by the waves; but his letter drew forth an explanation from another correspondent who saw the nuts "planted" by the Commander of a passing ship. Nevertheless, coconuts were no doubt carried by the sea from their original habitat, the Eastern Archipelago, both eastward to the Pacific isles and America, and westward to Ceylon and Africa, taking root and growing on the coasts on which they drifted.

Mr. Carruthers (Acting Director) for 1902: - "Advice has been given as to the value of *Mimosa pudica*, the sensitive plant, as a nitrogenous manure dug in ; the roots of this plant usually contain a high proportion of the nodules caused by bacteria which produce nitrogen, and experiments with this plant are so far most encouraging.'

It has been commonly remarked that the uses of the coconut palm are as numerous as the days of the year. Food, drink, domestic utensils, materials for building and thatching, wine, sugar and oil are

* See a very practical paper on "Profitable Coconut Cultivation in Ceylon' by an old planter, page ii in appendix. Mr. W. H. Wright at Mirigama has trees coming into bearing at 5 and 6 years and this has also been the case in the Chilaw and Rajakadaluwa districts. See his paper on pages iii-vi of appendix. 14 acres at Mount Lavinia with 1,151 bearing trees averaged 51½ nuts per tree for ten years—see page iii of Appendix. Much useful information will be found in the "Tropical Agriculturist" and in the "Agricultural Magazine,' Colombo. We quote a veteran planter:—

"The method followed by me upon my plantation of 275 acres when planting out the young palms—namely cutting the necessary holes about 3 ft. square and 36 in. deep and burning in them all cast-away wood and all rubbish and planting the young palms after the ashes thus obtained have been well forked into the soil is, I observe, being followed by some of the natives with very good results, which they thoroughly appreciate, and I have no doubt that gradually the system will be generally observed."—*W. H. Wright.*

amongst the many gifts to man of this munificent tree.* Unlike the other trade staples of Ceylon, tea, rubber, coffee and cinnamon, a very large proportion of the products of the coconut palm—nuts, oil, arrack, leaves for thatch, fences, mats and baskets, timber, &c,—are locally utilized. Arrack in varying quantities (according to the demand in the Madras Presidency) is exported, but the export is not to be compared to the large local consumption which unfortunately increases with the increasing wealth of the people. The British are blamed for regulating and encouraging the arrack and liquor traffic, but the consumption was considerable before the British appeared in Ceylon. We believe, however, that taverns and illicit grogshops are too widely multiplied, and that we should take a leaf out of the Dutch policy in Java, where the consumption of intoxicating liquors among the natives is very rigidly restricted. A good many million of coconuts are exported, the trade in this form developing largely of late years, to the Continent of Europe, but the chief trade is in coir fibre from the husk and the expressed oil chiefly used in Europe as a lubricant, specially for soap-making† and dressing clothes, and partially for candle-making and lighting purposes; African palm oil and petroleum being the great rivals. The maximum value of products of the coconut palm exported may be taken at about the following figures:—Oil £500,000; Coir 150,000; Arrack, £2,000; Copra (the dried kernel sent to India for native food and latterly to France to be expressed) £260,000; Nuts, £50,000,000;

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* The following are only a few of the countless uses of this invaluable tree. The *leaves* for roofing, for mats, for baskets, torches or chules, fuel, brooms, fodder for cattle, manure. The *stem of the leaf*, for fences, for pingoes (or yokes) for carrying burthens on the shoulders, for fishing rods, and innumerable domestic utensils. The *cabbage* or cluster of unexpanded leaves, for pickles and preserves, The *sap*, for *toddy*, for distilling arrack, and for making vinegar, and sugar. The *unformed nut* for medicine and sweetmeats. The *young nut* and its milk, for drinking, for dessert: the *green husk* for preserves. The *nut*, for eating, for curry, for milk, for cooking. The *oil* for rheumatism, for anointing the hair, for soap, for candles, for light; and the *poonac*, or refuse of the nut after expressing the oil, for cattle and poultry. The *shell of the nut*, for drinking cups, charcoal, tooth-powder, spoons, medicine, hookahs, beads and bottles, and knife-handles. The *coir* or fibre which envelopes the shell within the outer husk, for mattresses, cushions, ropes, cables, cordage, canvas, fishing-nets, fuel brushes, oakum and floor mats. The *trunk*, for rafters, laths, sailing boats, troughs, furniture, firewood; and when very young, the first shoots, or cabbage, as a vegetable for the table. The entire list, with a Singhalese enthusiast, is an interminable narration of the virtues of his favourite tree.—*Tennent*.

† Soap made at Hultsdorf (and ? other) mills, was exported from Ceylon, 660 cwt. in 1890 worth R24,140; in 1892, the export was only R475 worth; in 1893-4, no exports; while R127,516 worth of soap was imported in 1894. In 1897, exports none: imports 10,670 cwt. R214,611 paying R14,966 of duty. In 1902 the imports were 3,909 cwt. of toilet soap valued at R29,629 and 19,817 cwt. of bar soap R122,690.

Poonac, £50,000; Desiccated Coconut £150,000, Miscellaneous products £3,000 = say £1,200,000*—while the value of the produce locally consumed must be from 18 to 20 million rupees per annum, and the market value of the area covered with coconuts approximates probably to twenty millions sterling.† The extended local use, as well as cultivation, of coconuts is certain to go on with Railway Extension to the North and the development of the coast districts as well as of part of the interior of the island.—Ceylon Coçonut Oil in London has varied from average £38 per ton in 1877 to £39 10s. in July 1907; Copra has run up to so high a price as £33-10s per ton, during a great boom in May to June, 1902; but the highest price obtained in 1907 up to September, was £27. 17s. 6d. per ton. The cause is said to be a great demand for soap and candle-making.

The distribution of the Ceylon coconut products exported may be seen from the following table for the last complete season.

DISTRIBUTION OF THE EXPORTS OF COCONUT PRODUCTS DURING YEAR 1906.

COUNTRIES.	Coconut Oil.	Copra.	Desiccated Coconut.	Poonac.	Coconuts.	Coir.		
						Rope.	Yarn.	Fibre.
	cwt.	cwt.	lb	cwt.	No.	cwt.	cwt.	cwt.
To United Kingdom ...	179925	12463	10356389	80	11681806	125	67594	42824
,, Austria ..	97181	68544	353600	..	51040	...	300	1109
,, Belgium ...	12378	30612	802230	110576	817830	...	1352	34141
,, France ...	5	19154	72351	...	829	13	1226	3600
,, Germany ...	31762	174682	3223930	131986	1246307	...	13139	30492
,, Holland ...	5237	..	567400	200	484458	...	1317	3823
,, Denmark ..	7	48726	90230	101	42935	...	...	150
,, Italy ...	1003	6000	..	..	7980	...	2100	230
,, Russia ...	...	64045	8900	..	..	...	...	...
,, Spain ..	..	...	187960	...	..	...	...	...
,, Norway & Sweden ..	2641	...	45500	...	...	...	...	...
,, Turkey ..	...	...	250	...	1000	..	..	130
,, India ...	91126	147	...	68	8800	23	6559	708
,, Australia ...	16	..	1008673	...	32400	30	1131	7695
,, America ...	89545	...	2608090	..	61000	..	2025	17511
,, Africa ..	272	...	63903	...	1346106	90	...	11092
,, China ...	220	...	130	...	...	..	261	3
,, Japan ..	402	...	...	...	5000	..	40	1124
,, Straits Settlements...	..	...	...	...	...	19403	324	735
,, Mauritius ...	...	...	...	...	...	...	...	123
,, Malta ..	..	...	..	...	...	..	6	...
Total Export from 1st Jan. to 31st Dec. 1906	511720	421373	19384546	243011	15787491	19684	97374	155490

* The Ceylon Customs give total value—see Trade of Ceylon in Addenda—for 1906 of Coconuts Palm Products at over 19 million rupees. Of coconut oil we exported as much as 551,000, cwt. in 1892 (the year of greatest export, so far); of Coir about 215,000 cwt. were sent away in 1900, prepared in great part for brush-making—there are 24 coconut fibre factories in the United Kingdom—and a large export trade is springing up in Coconut poonac and copra to the European continent to express oil and for feeding purposes: 10 Coconuts go to a gallon of oil worth R1 to R1¼. In Jaffna 1,000 full-grown nuts will give 525 lb. Copra dried = 25 gallons oil = 2 cwt. fully.

† In taking over land for public purposes each bearing coconut palm is valued at R10, and in Native Gardens, there are 80 to 100 trees at least per acre—let us say £50 an acre, and without counting young or old palms that would give us for 750,000 acres, a total value of £37,500,000!

Here is an iteresting return made up to date of the closing of the old commercial season:—

EXPORTS OF PRODUCE OF THE COCONUT PALM:—1877-1889.

TOTAL EXPORTS;	Coconut Oil † Cwt.	Copra Cwt.	Coconut Poonac Cwt.	Coco-nuts No.	Coir, Cwt.			Total shipping ton freight approximate.	Total approximate Value of all.
					Rop	Yarn.	Fibre.	Tons.	R.
1stOct. 1888 to 30 Sept. 1889	327,420	139,671	117,982	4,376,657	9,074	78,702	28,710	60,000	12000000
Do 1887 do 1888	385,758	173,173	114,863	5,411,572	7,915	79,840	27,826	70,000	12500000
Do 1886 do 1887	304,478	108,035	112,180	9,437,618	9,570	69,097	20,546	59,970	112[illegible]7321
Do 1885 do 1886	234,308	127,899	42,481	*a*	7,816	74,146	17,219	47,172	9825455
Do 1884 do 1885	274,998	178,361	54,245	...	10,419	81,057	12,732	52,533	11376243
Do 1883 do 1884	423,820	177,345	*a*	...	14,473	85,195	13,672	61,243	14368649
Do 1882 do 1883	306,299	102,827	...	...	11,792	69,866	18,008	46,210	10894040
Do 1881 do 1882	183,768	51,004	...	...	7,479	65,885	6,199	28,992	6393495
Do 1880 do 1881	247,113	43,337	...	...	11,640	43,747	6,117	30,048	7489871
Do 1879 do 1880	316,503	*a*	...	...	7,290	56,828	5,862	30,597	8614520
Do 1878 do 1879	213,822	...	...	...	8,201	51,905	9,676	15,229	6589025
Do 1877 do 1878	112,825	...	...	...	7,810	57,671	5,347	18,176	4644270

We supplement this with the export for the past seventeen calendar years according to the Chamber of Commerce return:—

TOTAE EXPORTS FROM 1ST JANUARY TO 31ST DECEMBER.

		Coco-nutOil cwt.	Copra. cwt.	Desiccated Coconut. lb.	Coconut Poonac. cwt.	Coconuts.	Coir, cwt.		
							Rope.	Yarn.	Fibre.
1906	...	511720	424373	19384546	243011	15787491	19684	97574	55490
1905	...	576274	381238	20072905	262229	17715608	20952	106680	145958
1904	...	463352	671562	17804030	233749	16571342	21657	89405	120256
1903	...	649447	703819	17062194	295125	12703709	20506	83764	129275
1902	...	512498	374796	16227565	247697	12588212	15631	77157	116000
1901	...	453531	439865	14055493	204356	14850781	13030	75788	122826
1900	...	443959	362467	13604913	185992	14995909	12572	87415	115090
1899	...	400979	325401	13571084	174786	11723392	12090	75525	91588
1898	...	435933	506277	13040534	216620	12027714	12333	75819	95779
1897	...	409600	106601	12054452	192479	13610508	11732	91460	74470
1896	...	343797	50049	10603598	138358	13858881	10343	68326	56516
1895	...	384140	30765	8551073	174175	10800712	12082	90112	77226
1894	...	487571	30642	5722202	165156	8292699	14416	91746	67738
1893	..	389712	44923	6414908	188538	11079023	7819	84831	56404
1892	...	550977	134590	3849724	204166	9717386	7895	101375	43445
1891	...	409521	45660	1416330	192210	6699403	10576	90699	37897
1890	...	362690	129502	*b*	145088	11907969	9379	75030	35967

A great enemy in Ceylon to trees between their 5th and 10th years is the large Kuruminiya beetle. Caterpillar blight is also not unknown in Ceylon in isolated patches. For a couple of years, fear was excited in the Western Province about a supposed coconut leaf disease, but Dr. Trimen dispelled the idea of a fungus or other serious

a No records previously.

b No records previous to 1891

attack—see the remarks in his Admistration Report for 1889. See also Reports by Mr. Drieberg of the Agricultural School in *Tropical Agriculturist* of 1889-90. In his Report for 1900, Dr. Willis says of Coconuts :—

"The industry seems in a prosperous condition, and the trees are on the whole remarkably free from any serious disease, considering how long they have been cultivated in the island." But more recently alarm has been felt. The appointment of a Coconut Palm Inspector in the Straits is an example that should be followed in Ceylon, giving him power to prevent overcrowding of plants as well as neglect of beetles, &c. An ordinance respecting Plant Pests (No. 5 of 1901) will be useful in reference to a "bleeding" disease of the stem, due it may be to a fungus on which Mr. T. Petch, Mycologist, has made an able Report to the Ceylon Agricultural Society, which will be found in the Appendix. A "bud" disease in some other countries is giving trouble though not as yet in Ceylon.

The coconut palm was long supposed to be a native of South America, and to have been introduced thence to the Eastern Hemisphere: but De Candolle in his "Origin of Cultivated Plants" concludes its original home was rather in the Eastern Archipelago between the Andamans (which now yield 15 millions nuts a year) and New Guinea. It is found nearly everywhere within the tropics, and to the palmivorous inhabitants of many countries it is almost their sole dependence for food.* Bennett speaks of five varieties in Ceylon, and says the coconut nowhere else acquires the height it does in this Island. A tropical native with twelve coconut trees and two jak trees in his garden is said to be independent.† Although strictly a tropical plant and flourishing best in maritime belts, yet the coconut grows up to 26½° N. Lat., as far as Lucknow in India, and, as we have said, up in the interior hill-country of Ceylon for 100 miles from the sea at an elevation of 2,000 feet (or up 3,000 feet though not bearing), also in the lowcountry of the North-Central Province quite in the interior. In the Madras Presidency along the Malabar and Coromandel

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* A case is reported in 1883 from the South Pacific of a shipwrecked crew on an island there, living for months on nothing but coconuts (fish very occasionally) and flourishing and gaining weight.

† Tennent notices a case in Ceylon where a claim in court was for the 2520th part of ten coconut trees.

coasts there are, perhaps, 250,000 acres planted with the coconut palm, which is also abundant in the Maldives and Laccadives. The native state of Travancore alone exports copra, coconut-oil, coir and coconuts to a considerable amount, perhaps 5 lakhs of rupees yearly. India exports from 1½ to 2 millions gallons of coconut-oil annually, but also imports over a million; exports 40,000 to 60,000 cwt, of coir yarn, besides 400,000 cwt. manufactured and 40,000 cwt. coir rope; and copra up to 90,000 cwt. For India altogether we should be safe in giving 350,000 acres under cultivation; but India imports over 10,000 cwt. copra and over 18 million coconuts. In the Straits Settlements (Singapore exports 120,000 tons copra), Penang more especially, it flourishes, and in Java and Sumatra as well as throughout the Eastern Archipelago, the Philippines (exports 35,000 tons copra, 500 tons coconut oil and 8 million nuts in 1899) and New Guinea. The cultivation of coconuts and other palms is receiving attention in French Cochin China, about 60,000 acres having been reported as planted with immense room for extension; also in Siam and in New Guinea. In Zanzibar (£90,000 of copra exported in 1893) and along the African coast, especially in the German, British and Portuguese settlements, the coco-palm is freely planted, with large exports of copra, oil and nuts. A native chief has some on a lakeside beyond Nyassaland. The coconut plantations in Demerara have been fearfully devastated by the attack of a small beetle (*Passalus tridens*); in Jamaica there is trouble with a scale insect in very dry weather.

In Jamaica (also Bahamas) coconut cultivation is being much encouraged, about 14,000 acres being planted, export 10 millions of nuts; also in Trinidad, where 5,000 acres are planted, 8 millions nuts exported and 2 oilmills at work. Dr. D. Morris is of opinion that there is great scope for profitable coconut cultivation round the coast of the West Indian Islands, a convenient market being found in the United States. He counts on £10 per acre covering all outlay at 60 trees to an acre, till trees are in bearing. Mexico exports £250,000 of coconut oil; Venezuela has numerous coconut groves as also South and Central America. There are coconut groves 200 miles long on the coast of Brazil, whence a good many millions of coconuts are sent annually to the United States. The cultivation is also being extended in Northern Australia with success. In the Pacific Isles, New

Caledonia, Fiji (20,000 acres and 100,000 cwt. copra exported, &c.,) the palm is very abundant.

APPROXIMATE ESTIMATE OF AREA CULTIVATED WITH THE COCONUT PALM.

Ceylon ... ... Acres	750,000
British India and Dependencies	400,000
Central America	250,000
Eastern Archipelago, Philippines, N. Guinea & Straits Colonies	350,000
Java and Sumatra*	250,000
Mauritius, Madagascar, Zanzibar, Seychelles, Reunion, & African Coast	110,000
Pacific Islands, including Fiji, New Caledonia, &c. ...	260,000
Siam and Cochin-China	100,000
South America	500,000
West Indies	110,000
Total...	3,080,000

with perhaps 210,000,000 trees bearing fully 6,500,000,000 nuts every year, the larger proportion of which are consumed for food purposes where produced. Coconut-oil for lighting purposes used to be very generally consumed in India and the Eastern Archipelago and also throughout the Pacific; but it has been almost entirely superseded by the mineral kerosine oil, which is being imported in increasing quantities every year from America and Russia† and is cheap and good. In European countries, although large quantities (for soap-making, &c.) are still sent there from Ceylon, India, the Straits, Sydney, and the Pacific, yet the African palm oil has competed with it in the market.‡ The African oil palm has been planted in Ceylon and grows well in Lower Haputale and Kelani Valley.

Coir is exported chiefly from Ceylon, Madras and the Straits; coconuts from South America, the West Indies, as well as the East. The export trade of India in all products of the coconut palm is equal to an annual value of £400,000, but she imports £150,000 worth of nuts and copra; of Ceylon rising above the million sterling (with large home consumption both in Ceylon and in India); of the Eastern Archipelago, Java, and Saigon, £200,000; of the Pacific Isles and Australasia, £150,000; of Central and South America, 300,000; of the West Indies, £100,000; and £100,000 for the rest of the world's trade in coconut produce. Fiji's export of copra rose from 2,397 to

* Java exports in some years, 500,000 cwt. copra.

† Now being found in Burma and Borneo.

‡ The West African oil palm has of late years supplied most of the oil imported into Britain, the quantity having risen from 300,000 to 1,000,000 cwt. per annum in thirty years, while a good deal is also sent the United States and Marseilles direct Castor (200,000 cwt.), Olive and Seed Oil are also available.

5,000 tons between 1875 and 1885, but has since fallen off. 40,000 tons copra a year pass through Singapore.

An important industry in preparing Desiccated Coconut for confectionery has sprung up in Colombo, at Veyangoda, Negombo, Madampe, Kurunegala and other points in Ceylon under European, and later, under native auspices, and in 1906 the export of the product equalled 20,362,384 lb. (requiring nearly 60,000,000 nuts) valued at 20 cents a lb. locally or a total in Customs accounts of R3,404,000 (£190,000).—639 cwt. "Coconut shells" were exported to India in 1906, valued at R21,190.

See an interesting official report on Ceylon Oils exhibited at the Colind Exhibition in Supplement (page *f*) to *T.A.* vol. 1886-7.

COCONUT CULTIVATION.

(From the *Ceylon Summary of Useful Information and Plantation Gazetteer*, for 1859.)

COMPILED BY THE LATE A. M. FERGUSON, C.M.G.

Jaffna, as the scene of the most extensive experiments in coconut culture by Europeans, first claims our attention. Sir Henry Ward, in a Minute descriptive of one of his tours in 1857, thus noticed the Jaffna coconut estates, their condition and prospects :— The coconut estates of the Northern Province are confined to the Patchelopalli district, which extends from Kodigama to Pass Beshuter. The principal estates lie between the 17th and 28th milestones, right and left, on the road to Jaffna. There are only two estates —that of Mr. Dunlop,—and a new clearing belonging to Messrs. Wilson and Ritchie,—beyond the 28th mile ; but the whole of the estates depend upon the main line of road for their supplies, and the conveyance of their produce to the Port of shipment, which is either Point Pedro or Jaffna. It is, therefore, of the greatest importance to them, that this road should be completed, and it was under the belief that it would be so,—though I am not aware of the existence of any positive engagement to that effect,—that, as I have already stated, 10,000 acres of Crown land were bought, and £200,000 expended in bringing it to its present high state of cultivation.

"Having inspected, personally, six of the principal estates, and other gentlemen of my party having visited several of the remainder, I am enabled to state that they are all in a most satisfactory condition,—well fenced, well cultivated,—and rapidly approachin

the period when a very large amount of copperah, or oil (should steam machinery be established at a convenient point), may be prepared for exportation."

To a correspondent who was at an early period connected with the enterprise we owe the following interesting notice:—

"Europeans first turned attention to coconut planting in the Northern Province of the island so far back as 1842, during which and following years small portions of the two oldest estates were planted, and clearings rapidly increased up to 1849 and '52—but of late years the cultivation has not been extended to an equal extent, the result not being so satisfactory as was first anticipated, and the chance of any remunerative return being more remote than was first estimated.

"The expense attending the upkeep of the properties has necessarily been curtailed as much as possible, and probably in some instances to the detriment of the trees, for there is little doubt of ploughing and manuring being highly efficacious to their productiveness.

"The coconut tree is said to bear well, from the 9th or 10th year of planting, but experience does not justify this assertion, in the Northern Province, for we have no export of oil from that quarter as yet of either plantation or native produce, though several hundred acres are from 10 to 15 years old.

"The collection of nuts is, however, generally on the increase on the oldest estates—these are converted into copperah which is sent to Colombo, and also Coastwise, where it sells for a high figure, being generally of a fine pure quality.

"The nature of the soil is light and sandy, in which the coconut undoubtedly thrives best, when carefully cultured and plentifully watered in its tender age; but the planters' great enemy is the Cooroomenia or coconut beetle, which is found to be most destructive to the trees between the 5th and 10th years, when they expand and first blossom. Trees so attacked seldom recover and are immediately replaced with young plants, which cause a heavy item in the unkeep of the properties. The country is generally very level, and the best lands are those where surface water is procurable at a depth of 6 to 9 cubits in a light soil, a stiff clayey substratum being very objectionable.

"The climate may be considered a dry one, there being little rain except during the months of October, November and December, and again at the change of the monsoon in April and May.

"The Northern Province is famous for its good roads, and the planters have the advantage of the main trunk line passing through the

district of Patchelappalle in which the estates are chiefly situated. The labour employed is entirely local, and can be obtained at cheaper rates than in any other part of Ceylon."

A second gentleman, to whom we are indebted for the list of estates, accompanied it with the following remarks :—

"Coconut estates have been planted since 1841 (I think) and now cover about 9,000 acres, cultivation still being extended. For some 4 or 5 years proprietors were so discouraged at the non-receipt of anticipated profits that they reduced the expenditure on the estates to a minimum. Since a more liberal expenditure has admitted of higher cultivation, there has been a vast improvement—during the last two years this has been very marked. All the estates have more or less young cultivation, so that it is not easy to strike an average of the bearing of the trees; again, some estates or parts of estates are planted at 20 feet apart giving 108 trees to an acre; some at 30 feet giving only 48 trees to an acre—others at intermediate distances—so that it is not easy to give the number of trees. Statistics go far to prove that the annual increase of nuts throughout the district is from 50 to 78 per cent, an increase very unequally divided between the estates according to age and cultivation. This year's crop will be between 3 and 4 million nuts.* There are a few estates which have never been cleared and 4 or 5 blocks—about 1,000 acres surveyed but unpurchased—not much other Government land available for coconuts. I cannot estimate the quantity of coconut land held by Natives, but there must be two or three times as much as the extent held by Europeans, and their cultivation is increasing rapidly. The produce is principally sold as copperah, which is shipped in large quantities to Colombo and different parts of the Coast, being of such fine quality as to command a high price. At Calcutta it would doubtless compete successfully with that shipped from Quilon and Aleppee. Coir is only manufactured at Jaffna for the market, excepting at an establishment at Chavakachcheri. This arises from want of facilities for preparing the husk when there is a command of labour. The coir manufactured at Jaffna (entirely by natives) can be purchased at ½*d.* per lb. and is good in quality and procurable in tolerably large quantity. You know the climate of Jaffna, so I need not say that our chief want is rain, as we have little except in November and December. This, however, secures us very fine copperah. About 1,200 estate nuts and 1,400 village nuts give a candy of copperah 560 lb. Another great want of the Planters is mills for the manufacture of oil. Why should not we get as high a price for our copperah as is given in Colombo, when oil manufactured on the spot

* In a subsequent communication the writer says:—"I begin to think that trees planted at 30 feet apart will yield more nuts per acre than the others. Time is required to decide the question." He then refers to a beautiful estate planted 20 feet apart where the trees do not bear anything like what their appearance would indicate. On a part of the estate indigo was planted, but this was only for a year; still it may be the cause of the deficiency of nuts.

might be shipped direct to England? Beetles are not nearly so destructive as they used to be."

Taking the Eastern Province next in order to the Northern, we come to Batticaloa, where coconut Planting by Europeans was commenced much about the same time as in Jaffna. The climate is moister than that of Jaffna, and so far more favourable. Cotton cultivation was tried by the European planters at Batticaloa, but we believe, with no more success than attended similar efforts at Jaffna. We are indebted to a resident planter for our list. Sir Henry Ward, in the account of his tour in 1857, thus notices the coconut cultivation of Batticaloa.—

"Between Karankotativu and Naypatemone—the southern extremity of the Batticaloa lake—we passed through the coconut estates under charge of Mr. O'Grady. Farther north, between Ondatchy Madam and Karan Colom, are those of Mr. Carey: and the estates of Mr. Munro and Colonel Spencer, under the charge of Mr. Robertson, lie 20 miles more to the North again, between Eraur and Ballechena.

"Mr. Gordon Cumming's estates are near Karan Colom. We saw, therefore, a fair proportion of the 4,000 acres said to be planted with coconuts in the Batticaloa districts. Generally speaking, I do not think them equal to the Jaffna plantations, or comparable to those about Natande and Madampe, in the North-Western Province. But none of the estates are yet in full bearing, having only been planted between 7 and 9 years. About 70,000 nuts, which are brought by the Moormen, at from £3 to £4 per 1000, was the last year's crop at Karativu; but this may be expected to increase annually as the trees gain in age and strength.

"Mr. Carey's estates are models of neatness. The nursery for the young plants is like a garden. The clearing and planting cost £5 an acre, which may eventually be reduced to £4. This includes the wells to be sunk, which are numerous, as the young plants require watering every day for the first year. The water is found at from 5 to 8 feet. The system pursued by the gentlemen named appears to vary little. They all manure highly. None have tried salt, and do not attach much importance to it as a manure. But this may, perhaps, be owing to the fact, that the soil itself is strongly impregnated with saline particles, especially that which is dug in the marshes near the estates, and spread over the roots of the trees."

It is curious that the planters of Batticaloa attach so little importance to salt as a manure, for Dr. Gardner stated that in Brazil as much as a bushel a tree was applied when salt was at 2s. per lb. No doubt His Excellency has adduced the true reason why the application of salt is not required at Batticaloa.

We believe the Governor's estimate of 4,000 acres in cultivation is rather above the mark. A planter connected with the district tells us that about 3,000 is nearer the figure.

There is one estate at Trincomalee, Ootoo Oday, the property of Mr. J. Wright. It is situated in one of the deltas formed by the Mahavillaganga where it enters the sea in Tamblegam Bay, and promises well."

[There has been a great extension of coconut planting in the Batticaloa District since the above was published.—*Compiler.*]

CENTRAL PROVINCE.

In the Central Province plots of coconut trees are few and far between, and so much prized that some which required to be cut down in the formation of the telegraph line, near Kandy, were valued at £5 each. At Badulla there is a good coconut garden flourishing at an altitude of 2,000 feet; but generally the coconut does not thrive well beyond the influence of the sea breeze. There is a pretty legend of a Rajah of the Inland regions of Ceylon being afflicted with leprosy, of which he was told in a dream he would be cured by resorting to the sea shore and drinking the juice of the nuts of a strange tree he would find there growing. The Rajah resorted to the sea shore and found all as he was led to expect; the trees were there, but no inhabitants. The latter incident, unfortunately, violates all principles of even legendary probability. Coconuts have doubtless floated to the Asiatic Islands on the sea, but a country is not usually peopled from its centre outwards. In our notices of the coffee districts we have mentioned the attempt made at sugar cultivation in the Vale of Dumbara, and the more successful one at Peradeniya, where a sugar estate is still kept up. Cotton was, we believe, tried by a Mr. Pooley and others in the neighbourhood of Matale, where the soil and climate are favourable. But until our population increases and labour is cheapened, or until the Manchester men give a higher price for cotton, we fear this cultivation will not succeed in Ceylon.

WESTERN AND NORTH-WESTERN PROVINCES.

A correspondent who has had large experience in the cultivation of coconuts in the Western and North-Western Provinces, writes as follows :—

"There is great anxiety manifested by the natives to cultivate coconut trees, and large purchases of land have lately been made for that purpose and estates also opened.

"As to climate and soil for the purposes of this cultivation, I am of opinion, that the face of the country from Dandugama to Madampe, is one of the best districts of the Island. The soil may be divided into three descriptions, and which are to be treated separately as follows :—

"1st.—White sandy soil, porous, light and poor in the extreme, and in which coconuts thrive badly and take a long time to come into bearing. To plant this soil contractors will jump at the offer, as the jungle is mostly very light and the operations of cutting, burning and rooting inexpensive; the Natives themselves won't plant much of this description of soil, for their own use. There is another description of this soil, a shade more mouldly and better adapted to this cultivation.

"2nd.—Dark loamy soil, which suits coconut trees very well, and in which by observing first principles in choosing nuts for plants* the trees could be brought into bearing five years and be worth from £10 to £12 per acre annually at present rates of copperah, viz., £3 7s. 6d. per candy first quality.

"3rd.—There is also in this fine district a reddish loamy soil which is most excellent for coconut cultivation, which is about £2 per acre annually more valuable than the soil I have just been describing.

"The cost of clearing depends on the density of the jungle or forest, and may be calculated per acre at £2 or £3 to £4 10*s.*, I mean for cutting, burning and rooting, for to cut down, burn and plant, without rooting, is one of the greatest mistakes ever a proprietor made. The rotten stumps become infested with beetles, which ultimately devour a large proportion of trees, and the young jungle, constantly growing up, becomes infested with wild pigs which feast on young trees in all directions, so that a proprietor loses fearfully in the long run by adopting native or cheap principle. I would not tolerate a man on a property who allowed a single jungle root to remain in the ground, so as to be reproduced. The native profit largely when they plant coconut trees by contract, as they invariablyt sow their own seeds which deteriorate the soil, for the cutting and burning of which the proprietor pays dearly. They reap a speedy and heavy profit, whilst the proprietor is injured in proportion.

'After planting, cultivation may be carried on at from 7*s.* 6*d.* to 10*s.* per acre annually by means of ploughing—I mean including all expenses, comprising—superintendent, watchers, bullock watchers, kanganies, coolies, beetlemen, &c. Young trees must be watered in dry weather at least twice a week; they must be cleaned about and kept free from weeds and creepers, at least four times a year—I mean the surface close to the trees where the plough can't reach.

"Now for yield of coconut trees after coming into bearing: 5 years to 8 perhaps as stated, but this depends altogether on climate, soil and the selection of a particular species of nuts for plants, and which species the rain or damp wether connot injure. It has a tough kernal, and this leads me to state that oil expressed from

* "By first principles" we believe our correspondent means, choice of good, healthy, *fully-ripened* nuts.

this species might be as firm as tallow in the home market. With fair average soil, good climate and even cultivation, as I said before the average yield ought to be about 50 nuts annually per tree, and by the introduction of the cheapest and best mode of manuring in this country, the average yield ought to be about 80 nuts per tree annually, and which nuts are from 12*s.* to 15*s.* per 1,000 in weight more valuable than the general run of the country. I give general results—as about houses, where ashes, &c., are about the trees, you could no doubt get nuts quite as large as any I could cultivate, but for an average general result like that above they can't be found.

"It is said that coconut trees are in full bearing at from 20 to 30 years, and that their entire duration is about 100 years —some natives say 150—but of course this imformation is all hearsay and I cannot myself give reliable information.

"The proportion of trees destroyed by beetle is very small if the preceding precautions are observed, and the hands, say one cooly to 100 acres, are instructed and provided with proper tools for catching them when they imbed themselves in the young trees.

"Coconuts, as food, are in general use amongst the Sinhalese— a small complement of the kernel grated on the curry plate is considered a very nice relish and very wholesome.

"Labour I find to be plentiful at all seasons: on the principle, the self-evident one, of good treatment, and regular payments,—I never yet advanced 10*s.* for labourers—my coolies always fill up their places before going to their country if I am much pressed for labour.

"The means of communication are on the whole very good throughout the district—fair average roads and the canal open with some annual drawbacks.

"P. S.—I ought to state that an estate in this district, 800 acres with about ¼ of the trees in full bearing, gives now in the year about 600,000 nuts worth, at present coppeaah rates, about £ 3 3*s.* per 1,000. Hurrah ! !"

"The estate alluded to is, we believe, that of Horekelle, once the property of Mr. David Wilson, but latterly of the Horekelle Company, Limited. From first to last it has been highly cultivated and manured, and was at one time, we suppose, the finest coconut property in Ceylon.

[Immense extensions of coconut planting in the Western and North-Western as well as Southern Provinces have taken place since this was written.—*Compiler.*]

VARIETIES OF THE COCONUT IN CEYLON.

Moon, in his *Cataolgue* (1824), enumerates the following varieties :—

Native Names.	*Translation.*	*English Names.*	*Scientific Names.*	
POL.	COCONUT.	COCONUT.	COCOS	NUCIFERA.
(1) Gin	Fire	—	—	—
(2) Gundira	Maldive	—	—	—
(3) Tæmbili	Copper-coloured	King	—	—
(*a*) Ratu	Red	—	—	—
(*b*) Kiri	Milky	—	—	—
(*c*) Gon	Bullock	—	—	—
(*d*) Ran	Golden	—	—	—
(4) Nawasi	Sweet or Edible-husked		—	—
(*a*) Nil	Green	—	—	—
(*b*) Ratu	Red	—	—	—
(5) Pæni	Sweet	—	—	—
(6) Bim	Ground	—	*Trichopus Zeylanicus*, Gært.	
(*a*) Bu	Downy	—	—	—
(*b*) Maha	Great	—	—	—
(7) Ratu	Red	—	—	—
(8) Waga	—	—	*Carculigo recurvvata*, Rox.	

127. COCOS, *Linn. Gen*, *n.* 1223.—Flores in eodem spadioe interfoliaceo simpliciter, ramoso monoici, bracteati, m. in parte superiore ramorum numerosi solitarie vel 2-ni, conferti vel sparsi : f, in parte inferiore sparsi, sessiles vel pedunculati, solitarii vel flore mascul° utrinque stipati. Fl. male asymmetrici. Sepala parva, triangularia vel lanceclata, acuta, erecta, valvata. Petala oblique oblonga, acuta, erecta vel patula, valvata. Stamina 6, inclusa, filamentis subulatis; antheræ lineares,acutæ vel obtusæ, basi 2-fida affixæ, erectæ. Ovari-rudimentum minutum vel 0-Fl. f. masculis sæpissime multo majores, ovoidei, perianthio post anthesin aucto. Sepala ovata vel ovato-lanceolata. crasse coriacea, erecta, imbricata. Petala sepalis inclusa, coriacea, basi dilatata, convolutivo-imbricata, apicibus brevibus vel elongatis acutis conniventi-valvatis. Discus annularis vel obscurus. Ovarium ovoideum vel depresso-globosum, 3-loculare, loculis 2 sæpius effætis, in stylum brevem attenuatum, stigmatibus subulatis erectis

demum recurvis ; ovula subbasilaria, adscendentia. Fructus ovoideus vel ellipsoideus, terus vel obtuse 3-gonus, vertice rostrato rotundato vel intruso, 1-spermus, stylo terminali, pericarpio crasso fibroso, endocarpio osseo extus fibroso basin versus 3-poroso. Semen loculo conforme, testa fusca rapheos ramil reticulata, albumine æquabili cavo vel solido radiatim fibroso ; embryo poro uni oppositus.—Palmæ humiles vel elatæ, inermes, caudice gracili vel robusto annulato sæpe basibus foliobrum tecto. Folia terminalia, pinnatisecta, segmentis ensiformibus vel lanceolatis æquidistantibus vel aggregatis 1-plurineviis apice integris vel uno latere dentatis vel plus minus profunde laciniatis, marginibus lævibus basi recurvis rhachi subtrigona superne acuta, dorso convexa, petiolo antice concavo marginibus lævibus vel spinosis, vagina brevi aperta fibrosa. Spadices erecti, demum cernui, ramis erectis vel cernuis ; apatha inferior brevior apice fissa, superior fusiformis vel clavata, lignosa, dorso sulcata ; bracteæ variæ. Flores albi vel flavidi. Fructus magnus vel mediocris.

Species enumeratæ ad 30, Americæ tropicae et subtropicæ australis incolæ, una in tropicis amphigæa. *Mart. Hist. Nat. Palm* ii. 113 (*excl. sp.*), *t.* 62. 64, 75, 78, *ad* 82, 84 *fig. dext and* 86, 87. *f.* 1, 88. *f. 3, a,* 7 ; iii. 289, 323 ; *palm. Orbign.* 92 (*excl. sp.* 4), *t.* 1, *f.* 1, 2, 3, *f.* 2, 9*d f.* 2, 30 B. C. *Kunth, Enum. Pl.* iii. 281. *Lam. Illustr. t.* 894. *Gœrtn, Fruct. t.* 4, 5. *Spach, Suites Buff. t.* 100. *Drude in Mart. Fl. Bras.* iii. ii, 398, *t.* 87 *ad* 97. *Barb. Rodrig. Enum. Palm. Nov.* 83. *App. Protest.* 43, *Roxb. or. Pl.* i, *t.* 73. *Griff, Palm. Brit. Ind. t.* 241. *Wallace, Palm Amaz.* 124, *t.* 48. *Traill in Trim. Journ, Bot.* 1877, 79. *Drude in Griscb Symb. Fl. Argent.* 283. *Spruce in Journ. Linn. Soc.* xi, 161, *Hook. Kew Journ.* ii. t. 1, 2. *Trim Journ. Bot.* 1879. *t.* 202.

THE CULTIVATION OF THE COCONUT PALM ("COCOS NUCIFERA") IN CEYLON

(*By a practical Coconut Panter.*)

INTRODUCTION.

We do not find in the coconut tree, as it appears in Ceylon, the characteristics of an indigenous plant ; we do not find it growing to maturity, and producing its seeds in the midst of other natural growth; but wherever nature resumes her sway, and maintains it, for a few years, on land in which this palm grows, we see it pine,

cease to bear fruit, and ultimately die off: the neighbourhood and agency of man seem necessary not only to its propagation and well-being, but to its existence. It is only found as a cultivated plant; starved and neglected indeed it may be, but never totally abandoned to nature, for a long period of years.

Though we may not grant it a place with indigenous plants we must admit that it has from a very remote antiquity ministered to the comfort of the inhabitants of the South and South-West coasts of Ceylon. It enters into every part of the daily life of the Sinhalese as food, drink, light, fuel, household utensils, and building materials; and since it has become an article of foreign commerce, it is the chief source of Sinhalese wealth and an important field of Sinhalese industry.

PRODUCTS OF THE COCONUT PALM.

Oil holds the first place in the exported products of the coconut palm: the progress of the trade has been, from 377,000 gallons' average annual export in the five years ending in 1851, valued at R290,000 [to 9,643,847 gallons, the average of five years ending in 1906 and valued at R9,643,847]. For fifteen years previous to 1851 the export of this article had been stationary, or rather declining. The cause of the rapid increase in the last forty years was the planting of extensive fields, by European colonists, which have been gradually increasing their yield.

The product of the coconut-palm second in importance to oil as an article of commerce is coir—the fibre of the husk. Not one-thousandth part of the husk produced in the island is manufactured. Machines driven by steam-power have been constructed for cleaning the fibre, but the great bulk of the coir exported is still prepared in the old way. The husks are thrown into a pool of brackish water, and left to ferment, after which they are dried, and the fibre beaten free by women and children. The wages to be made by this labour are very scanty; yet it is a domestic occupation that slightly mends the means of thousands of poor families.

Coconuts, copperah and arrack are not exported in large quantities, or to any certain market, as is the case with poonac. Copperah is the dried kernel from which the oil is extracted; poonac, the oil cake that remains after the oil is pressed out. Toddy, from which arrack is distilled, is obtained by cutting off the ends of the flower spikes about the time that they burst the sheath. The branch-

lets are tied tightly in one bundle, the end of the bundle is cut off, an earthen pot is attached to receive the flowing juice, and when the pot is removed with its contents a piece more is cut off the spike, to remove the ends of the sap vessels dried up and contracted by exposure. The sap thus collected is distilled into the spirit called arrack, which, though not an important article of foreign export, affords, through the excise levied on it, a very important branch of the Colonial revenue, the receipts in 1873 being over £180,000.

CULTIVATION.

Climate and Soil.—The lowest average temperature that the coconut will thrive in is 80 degrees Fahrenheit. In that temperature, less annual rainfall than 70 inches injuriously affects its crops. The most productive soil is the alluvial flats by the banks of large streams that are not too frequently or for long periods flooded. The second best soil is the deep brown gravelly loam, that is not prevalent in Ceylon, but is frequently met with both in low and mountain country: for instance, there are few better soils in the island than the vale of Matale offers for the plant, and as the other conditions of prosperous cultivation are found here, perhaps our great-grandsons may overlook from the Balakaduwa Pass a coconut field, extending beyond the most distant spurs of Ámbokka. The third quality of soil for coconuts, and the first in its capacity to respond to high cultivation, is a deep loamy sand. In alluvial land, the efforts of the cultivator must be confined to keeping down the indigenous growth; on the rich brown loam, operations must, for a long series of years, be the same in principle, only less in degree. It often happens in Ceylon that land of third-class natural fertility is most profitable to the cultivator: this indeed should not happen under a good system, but good systems are of slow growth, and have hardly yet reached the practice of the most enlightened of Ceylon coconut planters. Coconut cannot be planted profitably on a surface steeper than one in fifteen: cabook hills are especially to be avoided, where they have a greater inclination; clay and peat, inert, loamy and heavy retentive soils of all kinds are to be avoided.

Planting.—Almost all the old native gardens have been planted higgledy-piggledy, often 200 trees to the acre, beside jak, mango, kaju, and other trees. Your genuine native firmly holds the faith of the more trees the more fruit, and will rather discredit his

senses than admit that system handed down from his remote ancestors can possibly be wrong. This system would soon work itself out, but for the fact, that the whole rural population dwell under the shade of the coconut groves, and wherever man and his attendant domestic animals reside there is a constant process of natural manuring in progress. It is now some twenty-six or twenty-seven years* since Europeans began to plant coconuts on a large scale in Ceylon. The favourite localities were then Jaffna and Batticaloa, but many detached properties were planted throughout the Southern and Western Provinces. The habits and wants of the plant were so little understood in those early days of planting, that very many mistakes were made. In a great majority of cases the land selected was naturally barren; the climate of the Northern and Eastern Provinces turned out to be too dry; the estimated cost of bringing the fields into bearing had to be trebled; the period estimated between planting and bearing was doubled, and the crops seldom reached one-half of the original estimates. In consequence of all this, coconut planting has been a comparative failure; and even the most valuable estates yield a very low percentage on the capital invested. Things would have been very much worse but for a circumstance never calculated on in the original estimates, that is, the value of the produce has nearly doubled since the estates were planted. From 1848 to 1858, coconut planting was almost entirely suspended throughout the island, but in or about the latter year several circumstances combined to give it a fresh impulse. Government took measures to put into the market large tracts of land, in lots suitable to all purchasers, from 20s. to £1,000; the value of coconut oil had continued to rise gradually, for a series of years; the general prosperity of the colony had enabled vast numbers of natives of all ranks and professions to save more or less money, and true to the native habit of mind, they could not think it perfectly safe, till invested in immoveable property. The coconuts planted between 1840 and 1850 were chiefly by Europeans; those planted within the past fifteen years* are almost entirely by natives. The movement has been general throughout the Western Province, and the extent planted is immense. Taking the country alone between Katukenda and Giriulla, a distance of ten miles: in 1860 it was an almost uninterrupted forest for the whole ten miles: there are now 10,000 acres

* Written in 1873.

planted with coconuts, and in the three miles between Katukenda and Dalpatgedera alone there is a single field containing nearly 5,000 acres, more than four-fifths of which have been planted within eight years. In this district there is now, under one view, the largest systematically planted field of coconuts in the island, and the general soil of the whole valley is of a superior quality and may be expected to be very productive; yet it is only a mere fraction of the aggregate extent planted in the past ten years. In view of the vast increase that must take place in the supply of this staple within the next fifteen years* it is a serious question, whether the market will expand to absorb it all. It is true that the price has risen 25 per cent in the face of a supply nearly quadrupled, in the last fifteen years, but with the prospect of the supply being again quadrupled in the next fifteen and of the increasing receipts in Europe of West African palm oil and of petroleum oil, producers will not act unwisely in habituating their minds to the contemplation of a considerable decline in prices* This is, however, a mere speculation, and we have no right to look with gloomy forebodings into the future, if we do our best in the present.

SEED-NUTS.—The kind of soil suitable for coconut cultivation has been already indicated: the next step is the selection of seed nuts. These should be the produce of healthy, heavily-bearing trees; ripe, but not dry; of a bright green colour; of an oval shape, with a thin husk, and the three longitudinal ridges on the husk not prominent.

NURSERY.—The land selected for nursery ground should be light and free, prepared by trenching eighteen inches deep formed into three-feet beds, with two feet intervals; the earth should be removed to the depth of six inches, and piled in the intervals; pack the nuts close together in the beds, with the stalk ends up; return as much of the earth as will fill up all the open spaces between the nuts, leaving only the crown above the surface; settle the beds with a good jar of water, and then cover with three or four inches of cinnamon scrapings, or, if that is not to be come at, lay six inches of straw or grass over the beds. Water from time to time, if the weather is dry, and the plants will be ready for removal in from five to six months. All Plants

* Written in 1873. But instead there has been an increase in price, so great is the demand for coconut oil for soap-making, &c.

that have been tardy in springing, and all that have not a healthy vigorous appearance, should be rejected, as the first condition of an equal and healthy field is quick-growing seedlings.

TRANSPLANTING.—The common practice is to transplant the seedlings from the nursery to the field direct: but a plan suggested by an experienced Jaffna planter, some years ago, is worthy the careful study of every one proposing to create a coconut field. This plan was to select pieces of good land convenient to water and to plant the seedlings at five feet apart; to concentrate high cultivation on those spots, till the plants became strong and vigorous, while the land they were finally to occupy remained untouched. It was then proposed to clear the land, and transplant the trees to their final destination. The advantages of this plan are: that one man's labour will do more to advance the growth of the trees than could be done by that of twenty-five men in the wider space; that the larger surface is preserved for two or three years from the soddening influence of sun and rain on unshaded land; and that the plant can thus avail itself of the virgin strength of the soil when it is much better fitted to avail itself of it, than in its infant state. The only disadvantages are that the removal to a new locality of a plant of three years old is more costly than one of six months; but much more than this is gained by the quicker growth and the smaller cost of cultivation; and that transplanting always checks the growth of a plant, and the older it may be the danger is the greater. This is true of most plants; perhaps of all. But the coconut is less thrown back by transplanting at *any age* than almost any other plant, and three months under the most unfavourable circumstances is the utmost suspension of growth; trees of twenty years' standing have been transplanted that did not lose one leaf the sooner for the operation.

FELLING.—If the land to be planted is old forest, it should be felled about a month before the usual time that the first rains of the season fall. In from fifteen to twenty-five days after felling, fire should be set to the fallen timber, and this should in no case be deferred till the leaves have fallen, or till the undergrowth has made any progress. A good running fire is the means of saving much labour, not only immediately, but during subsequent years. On chena land the operations are the same, but as the timber is lighter the leaves fall sooner, and the undergrowth appears earlier: the fire should therefore be run in ten or twelve days after the felling.

In old heavy forests a good running fire completely destroys all vegetable life, but in chenas of less than thirty years' standing the fire is not strong enough to destroy the vitality of the roots, and in less than six months there is a fresh growth of jungle, which entails unceasing labour to prevent the young coconuts from being strangled and buried before they have a good hold of the soil. This labour is so indispensable and so persistently exacting, that, perhaps, the wisest plan would be not to plant any chena land till it has stood a sufficient length of time to assume some of the qualities of forest.

LINING.—As soon as the fire has run, the land should be lined. There has been much difference in practice in the distance between the trees, the extremes being eighteen and thirty feet. The one is decidedly too close, and the other perhaps too wide but the general practice has settled down into 25 feet, or seventy trees to the acre. It may not be an object of the very highest importance to have the trees exactly in their proper places, but it is not creditable to the skill and care of the planter if they are not. It will require a good deal of pains to lay down the lines, and carry them correctly, over a large field, but the result is worth all the toil and trouble taken. The universal arrangement is to plant on the square, that is, a plant at each corner. It would be a better arrangement to plant on the triangular principle. The leaves of a strong, quick-growing coconut tree are from 16 to 18 feet in length, and if they stood out at right angles with the stem each tree would shade a circle of from 32 to 36 feet diameter; but the natural droop of the leaves takes 6 feet from this diameter, so that on a square of 25 × 25 the leaves of adjoining trees will cross each other, to the extent of from two to three feet; thus every tree is more or less interfered with by four others, standing at equal distance of 25 feet, but the diagonal spaces being 35 feet, the leaves never meet across them. By planting so that trees in each line will break the spaces of the next, each tree will only be interfered with by two others at the distance of 25 feet, while the diagonal distances are reduced to 28 feet, across which the leaves will just meet, and not overtop.

HOLING.—The holes should be dug two feet deep, and three feet wide, or larger, if the plants are not seedlings; they should be filled in with the best surface soil to be found in the vicinity, but only for 18 inches, as it is important that the crown of the root should be six inches below the surface: the six inches left open will be gradually filled up level in the course of cultivation.

COCO-PALMS COMING INTO BEARING.

The only thing of real importance, for some years after planting, is to manage the natural growth of the land, so that it shall neither interfere with the spread of the roots below ground nor of the leaves above, and to stimulate lagging plants with a dose of manure. It is neither necessary nor advantageous that the whole surface should be made clean and kept clean, for a good heavy growth of weeds and low brush keeps the soil in far better heart than a clean bare surface would. No heavy jungle root retaining its vitality should be allowed to remain where the roots of the coconut have reached, but beyond this little is required for the first four or five years but to keep the natural productions of the soil within reasonable compass. After the fifth year the surface should be thoroughly cleaned, and all the remaining jungle roots either extracted or dealt with in some other way, to destroy their vitality. The object will then be to clothe the surface with natural grasses, fit to feed cattle. To this end, the surface should, after the first clearing up, be as little disturbed as possible: annual weeds should be pulled out by hand before flowering, and young jungle plants should be treated in the same way, but if they have a *dour* hold of the soil the hoe may be cautiously used. Cattle may be introduced as soon as the trees are out of danger from their nibbling, and the first use of manure should be to get forward such trees as have been making less progress than the general run of the field. The most beneficial way of applying manure to an individual tree is to mark a circle three feet from the stem, and beyond that open a trench, two, or not more than three inches deep, and two feet wide; spread the manure fairly in the bottom of the trench, and return over it the earth dug out; beyond this, and keeping the surface clear from every growth but pasture grass, nothing further is required till the trees begin to bear.

The length of time between planting and bearing will be owing to the soil and treatment. In the very best lands the most forward trees will flower in the fifth year; but even in the very best land the crops will be scarcely worth speaking of before the ninth or tenth year. After the tenth year, the annual increase of crop becomes rapid year by year, up to the twentieth, after which time all further increase will be due to cultivation and manure.

NATIVE MODE OF CULTIVATION.

Native proprietors always pay for the work of the first three years out of the natural fertility of the soil rather than out of their pockets:

to their minds, the former is a fund of unknown amount to be realised as early as possible, and in any form of draft; but capital that has once taken the form of colonial currency it is like skinning alive to place in a bank that only promises to return it with interest in the form of a deferred annuity, beginning in the ninth or tenth year, and gradually increasing up to the twentieth. They may believe in the promise of the bank, but they do not see how a present draft in the form of a bushel of kurakkan will deprive them of 150 coconuts they would otherwise realise within twenty years, and if they did, they would probably prefer saving 2/6 now to waiting all that time for 20/.

On land at all suited to coconut cultivation goiyas are always ready to undertake clearing and fencing, in consideration of being allowed to take a crop of kurakkan, of which the land-owner receives one-half, one-third, or one-fourth, according to the quality of the soil, and his own talent for making a bargain. The proprietor always finds the coconut plants, and generally arranges with the goiya for lining, holing and planting, to be requited by a portion of the land share of the crop. Sometimes a line of plantain trees are put down at ten feet apart between the lines of coconut the first year, and in other cases sweet potatoes are planted after the kurakkan crop, and, if neither of these plans is adopted, there is usually a second crop of kurakkan taken. By such means, a proprietor sometimes covers the cost of the land and the plants, and has money in his pocket when his plants are three years old.

It would take a chemical analysis to ascertain the amount of fertilising elements removed in a bushel of kurakkan, but an observing eye will certainly convey to a reflecting mind the idea that it is a very exhausting crop, not only in what it removes, but in its effects on the soil, hardening the surface and rendering it impervious to air, light and moisture. Plantains will only be fruitful in good soil, which they rapidly exhaust; yet under native treatment they are rather an advantage than otherwise to a young coconut field, because their shade is very beneficial to the soil, and left to nature they grow almost all to trees, and very little to fruit. In the richest soil to be found in the island the single plant will, in the course of two years, surround itself with a hundred young stems, and the clump will extend to the diameter of four or five feet; the most advanced shoots are crushed up and strangled by their hopeful progeny, which extend their roots further; the circle still continues to spread, with the same crowding, till the various circles meet, and

a whole field may thus die out in six or seven years without having in all that time yielded more than an occasional and accidental bunch of fruit. Sweet potatoes form a cover for the soil, that protects it from the influence of the sun, keeps down all other herbaceous growth, and renders it necessary to turn over the land, to reach the produce; they are not an exacting crop on the fertility of the soil, and probably do more good than ill to the land.

ENEMIES: WHITE ANTS AND CATTLE.

Forest or old chenas are not generally infested with white ants, but land that has been for any considerable time either completely or partially open is full of them; they are not partial to dry coconut husks, but they attack with great avidity such as are attached to young plants, and have been buried from six to nine months in the soil. When a young plant is transplanted, it requires a greater or less time, according to the weather, to throw out fresh roots into the surrounding soil, and is in the meantime supported and nourished by the husk. If, however, those insects take a fancy to it, they devour the husk in a few hours, and the plant inevitably perishes. The best way to deal with such land is to put down plants already two or three years old, but if it be necessary to plant seedlings, dissolve eight quarts of salt in a tub of water, thicken with fresh cow-dung, cover the husks with a coating of the mixture and let it dry before planting.

To get up a healthy coconut field it is absolutely necessary that cattle should be excluded, till at least the inner leaves are beyond their reach, as nothing dwarfs and retards the young plant so much as nibbling off the ends of the tender leaflets. The only security against this evil is a strong ring fence, that a bullock can neither break through nor leap over; such a fence, is a necessity for the first few years, and an advantage for ever.

FENCING.

A fence of dead wood will in no case last for two years, and if the work be done by goiyas it will be generally found to last their own time, and no more. A fence built with cabook stone and mortar, with a brick coping, is a strong and handsome affair; but it is a pity that it should be so costly. A mud-wall is not a cheap fence to begin with, and is continually subject to accident. A great variety of plants are used for live fences, in different parts of the island, but every one of them is more or less subject to the objection,

that they require care and labour to keep them secure. As care and labour cannot be dispensed with, in the case of any plants used for this purpose, the object is to find a plant that is not very choice in the soil it requires, that is of quick growth, and will become a secure protection, with the least possible labour. The Kaju-nut plant combines all those advantages: it is of rapid growth, has no fastidious predilections as to soil, its growth can be turned in any desired direction, and a moderate amount of labour will make and maintain it a perfect security against the ingress of anything bigger than a hare.

The method of getting up such a fence is: dig up to the depth of nine inches a strip a foot wide along the proposed line of fence; in the earth thus broken plant the nuts two inches deep and six inches apart; in average soil the plants will be three feet high in a year. When they have reached this height more or less they should be bent over and intertwined along the line of fence. When the fresh vertical shoots, that will spring from the bent stems, are from two to three feet in length, they should be intertwined again, in the opposite direction. The process should be repeated with the third set of shoots, by which time the fence will be four and a half feet in height, and from that time the only further operation necessary is to cut the vertical growth, from time to time, down to the standard four and a half feet. Such a fence, so trained and treated, will be a perfect protection within three years, and will remain so for at least one generation.

BEETLES AND OTHER ENEMIES.

The next enemy in the order of its attack on the coconut plant is the black beetle. This insect attacks the plant as soon as they have substance enough to satisfy its voracity. It gnaws its way into the tender undeveloped leaves, in the centre of the head, on which it feeds. It sometimes—but very seldom, and that only on trees under two years old—cuts down the centre, and kills the plant; but they generally spare the life of the tree, for the sake of future feasts—indeed, except in very young trees, they are rather a stimulant than otherwise. The trees that are specially palatable to them are always ragged and miserable in appearance, but, as they attach themselves to the most forward and thriving trees, they do not deform a field to the extent that might be expected. The common course of warfare against this insect is impaling it with barbed wires, when it is actually at work in the tree. It is, however, questionable whether this war on the perfect insect

would be as effective as a campaign against the grub. Wherever there is decayed vegetable matter, there the grub is found in abundance, as a fat, white worm two inches long and as thick as a man's little finger, when near maturity, but presenting its specific character at all stages. In lessening this evil, two men will do more, if well directed in hunting for the grub, than twenty searching for the perfect insect in the trees. A whole district might be absolutely cleared of them if one system was adopted, but what is the use of science to myself, when my neighbours breed beetles enough to make their own trees and mine equally forlorn and beggarly?

The bandicoot rat follows cultivation, the porcupine retreats before it, but both are equally dangerous to a young coconut field; the only way of dealing with either is to trace them to their dens and destroy them there. It is exceedingly nasty to find trees of from two to six years old eaten right through their stems, close to the ground; but hunting is the most congenial occupation of man, wild or tame and the offer of a handsome reward will set a whole village on the alert—men, boys and dogs.

The red beetle is by far the worst and most deadly foe of the coconut tree: it becomes liable to the attack of this insect as soon as it forms stem, and is not safe till, or even some time after, it comes into bearing. The black beetle in its perfect state feeds on the young undeveloped leaves; the red beetle in its perfect state has no organs of nutrition, and feeds on nothing, but its grub devours the very substance of the tree, and in many cases the fall of the head is the first intimation of its presence; its ravages are so extensive that some properties have been known to lose one-third of their trees within the first ten years. The beetle deposits its eggs wherever it finds a wound or a crack in the smooth, hard, outer rind. As soon as the grub is hatched, it commences to eat its way into the centre, with a course upwards and inwards, enlarging the opening as it grows As it approaches to maturity it returns to the surface, and rolling itself in a cocoon of fibre it awaits maturity, and it generally leaves the outer rind as thin as writing paper. The beetle has no difficulty in making its way out; it sometimes, however, cannot do so, and perishes in the tree. The only really safe measure with a tree into which the grub has penetrated is to root it out and burn it to ashes. It is sometimes cut out, but this only appears to save a tree, the stem of which has become too hard for its operations. Although little or nothing can be done in the way of remedy, much may be done for

prevention. The coconut stem expands within a sheath of embracing leaves supported by strong fibrous webs that only slowly yield to the pressure from within. At the time the young stem emerges from the ground it is very tender and easily injured: nature has therefore provided that, at this period, the sheath of leaves and webs shall cling to the stem with a persistent tenacity, unknown at a more advanced period of growth; the leaves do not fall off, but rot off, and so long as there is a sound fibre it sticks. If nature has made a mistake in this direction, then the cultivator is justified in lending his aid to get rid of an encumbrance; but if Nature does nothing in vain then the artificial removal of the ragged and decaying sheath is rather to thwart than to aid her purpose. In removing a dry, tough fibrous matter, probably with a blunt catty, there is great danger of inflicting a wound; and even if this be avoided the laying bare to the weather of the young tender stem, before the outer rind is sufficiently hardened and compact, causes cracks, that are for some time equally dangerous with an artificial wound. To lay it down as a rule, that no part of the tree above ground is to be subjected to any artificial process whatever, will be an almost absolute protection against the attacks of the red beetle, as it can no more get its eggs within the ripe rind of a coconut stem without wound or crack than it could get them into a jakwood plank. Scores of instances might be recorded where, till the trees came into bearing, a red beetle was never seen, but no sooner was the land cleared and the trees trimmed than it made its appearance, and became very destructive. On one property the trimming system had been carried on for years, till, indeed, more than one-third of the original plants perished, before the estate was ten years old, and they were going at the rate of three trees weekly. The work of trimming was stopped for the reasons offered above: the loss of trees continued for some time afterwards, but at the end of six months it had entirely ceased. On another property, beetle-men had been employed for ten years, and trees were being constantly lost: from the day that the "beetlers" were discontinued two trees perished within the month, and not another was lost in the subsequent seven years.

CULTIVATION WHEN TREES ARE BEARING.

The treatment of coconut palms in bearing is nearly uniform among natives; to take all that Nature yields and return nothing. Natural manuring goes on, to a greater or less extent, around every dwelling; nothing else is done in the village gardens from one

generation to another. There are vast numbers of properties in native hands, ranging in extent from five to one hundred acres. Some of these are kept in pretty good order, as far as keeping the land clear is concerned; others are neglected, some have been swallowed up in jungle. On properties over 100 acres in extent, the systems are almost as various as the men who manage them. The practice most common is to keep the surface clear of jungle, and encourage the growth of natural grass. As many cattle are generally kept as can be sustained by the pasture, and the manure is returned to the land, in some cases, by tying the cattle to the trees at night; in others by enclosing them nightly in movable pens. When they are housed in sheds, the manure is generally supplied in holes dug near the trees, or in shallow circular trenches, dug round them. Most who have a market for the fallen leaves, husks, and shells avail themselves of it. The most common way of disposing of those things, when there is no market, is to burn them, and either mix the ashes with the cattle shed manure or leave them on the surface, where they are burned. Some few properties are periodically ploughed, but this operation is not common in estate cultivation: in light sandy land, frequent stirring of the surface is not beneficial; but strong heavy soils, with a tendency to harden on exposure, cannot be ploughed too often.

On one estate in the Western Province the following is the mode of management. The whole crop of nuts is manufactured into oil on the place. The cattle kept on the estate have their will of the poonac tubs. When the price of this article is 5s. per cwt. or upwards, the remainder is sold, and the money received for it is expended on the purchase of the bone dust; when the price is low, the remaining poonac is turned into the cattle sheds. A trench, one foot deep and three feet wide, is opened in every fifth line of coconuts into which all the weeds that grow on the land and all the droppings of the trees are thrown twice a year, and when they are full they are covered up, and a fresh trench is opened in the next line. The husks are all carried back to the land and packed in trenches, nine inches deep and three feet wide between the lines and covered up. About 100 head of cattle are kept on the estate, from 40 to 50 of which are required for work, the remainder being breeding and young stock. The cattle are housed nightly in spacious sheds into which a fresh layer or litter, collected from the "deniyas" on the property, is daily laid. At the end of six months the sheds are cleared out, and the manure spread over the face of ten acres—more or less—

and dug in. When bone dust is used, it is sown over the same surface, at the rate of the three hundredweights to the acre, and dug in along with the cattle-shed manure. This system was introduced twelve years ago, when the property was in its nineteenth year, and has been improving and hardening for eight years. The results on the crops in that time are an increase of eighty per cent. in 1868, and an average of 50 per cent. for the first eight years, though three successive years of drought caused a falling-off of 14 per cent from the crop of 1863-64. The surface of this estate is almost a dead level, and the soil a very light sand, free and kindly, but exceedingly poor. It responded largely and rapidly to the application of manure, but the effect only lasted for three years, in the case of cattle-shed manure; guano has been found utterly ineffective, but bone-dust is highly satisfactory, less for its immediate effects than for its longer operation.

Every 40 cubic yards of cattle-shed manure contain the elements of 3,000 ripe coconuts, delivered within 4 years; from five to six hundredweights of bone dust is the equivalent, but it requires seven years to complete this return. Other manures have not been applied in this instance, but, if other planters will institute a like system of observation and publish the results, the exact value of all the different kinds of manure used might be made public property and coconut planters would cease to work in the dark. It would be a vast advantage to them, if they could distinctly ascertain from recorded facts that on a given soil such and such quantity of any given manure would give within a certain time a certain number of coconuts. Say that I expend £70 in making and applying 800 yards of cattle shed manure. I gain within four years £180, or upwards of 150 per cent. on the transaction. I expend £4 on the purchase, transport and application of bone dust: my return within seven years will be £9 or 125 per cent. over 20 per cent. per annum.

We will close this sketch with a theory of coconut cultivation drawn from the doctrines of agricultural chemistry. The fertility of a soil for any given purpose consists in the quantities and proportions of the soluble bases it contains, and in a lesser degree on its mechanical state, and the regular supply of the necessary amount of moisture. More or less of the fertilising elements in the soil are removed with every product that leaves a residue after burning. Coconut oil burns out without any residue: therefore the removal of the coconut oil from land takes away no part of its fertility. It follows that, if only

oil be removed from a coconut estate, and all the other products of the soil be restored in one form or other, the fertility of such land will never be permanently impaired; and another inference is necessary, namely, that every particle of fertilising matter brought into such land must increase its permanent fertility.

If this be the true theory, then the property from which only oil is removed has an important advantage, and may be kept up and improved at considerably less cost than those from which other products of the land are likewise removed. In the one case, the fertilising elements of the land are kept in constant circulation without diminution, while in the other a portion is abstracted in every gathering. On one estate the crops may be fairly expected to increase in exact proportion to the amount of foreign fertilising matter brought into it: in the other, they may with equal fairness be expected to diminish, unless an equivalent of foreign fertilisers is introduced. It is possible to give examples, but "comparisons are odious," as Dogberry remarks.

COCONUT CULTIVATION.

(By Another Practical Planter.)

THE REASON FOR WRITING.—As my opinions on coconut cultivation are still in advance of the common practice, I propose, in a series of short papers, to do justice to my own views, in the faith, that, so far as they are consistent with sound principles, they will gradually be accepted by the growing intelligence of those interested in this product, which, so far as the native industries of the Southern and Western Provinces are concerned, holds the first place, I have already opened the subject by a slight sketch of the commencement and progress of coconut estate cultivation, and I now proceed to treat the subject from the beginning

SOILS.—There are two kinds of soil on which coconuts refuse to grow to any profitable purpose namely, thin washed gravels overlaying solid cabook and stiff clays, both of which should be avoided; they will never pay for the labour; otherwise they are not particular. The richer the soil, they will grow the quicker and bear the earlier; and the heavier and, as a rule, the longer it takes to bear, the smaller will the crops be. The best of all soils for coconuts are deep alluvial loams, on the banks of rivers, subject to floods that overflow on the neighbouring lands; in such situations, the crops are enormous; indeed, a few acres of such land is a fortune to its owner, and, as the soil is particularly inexhaustible, it may go on for a century bringing in annually an income of R300 or more. Such pieces of land are generally small in extent, and widely apart. The next quality of soil is the brown loams, and they are only found in certain districts, and seldom extend into the higher uplands, where cabook gravel with varying proportions of loam prevails, and this is now almost the only description of land to be obtained. A loamy sand is a good coconut soil, and, with scientific cultivation, is only inferior to the alluvial and brown loams.

LAY.—The lay of the surface is an important factor in successful coconut cultivation; other things being equal, the nearer the approach to the level the better. Steep hill-sides are always poorer than neighbouring flats, and they become poorer from the base upwards,

while a flat hill-top is always better than the steep sides. Darwin's work on earthworms describes the cause of this scientifically, and I need not bring my rushlight into the presence of a flambeau.

NURSERIES.—Eight months before the plants are wanted for the field, a nursery should be put down with 50 per cent more seed nuts than the number of plants needed, because there are always a greater or less number or the nuts that do not germinate, and all that have not germinated within five months should be rejected, as likely to carry the same slowness of growth into the field; and to this cause, chiefly, may be ascribed the inequality of the trees years afterwards, when there has been no difference of soil or treatment to account for it. The selection of the seed-nuts is an important affair, and should be done with great care. The best way is to select the trees from which the seed nuts are to be taken; and the rules to go by are—a mature healthy tree in heavy bearing, the nuts should be medium size, with thin husks, and should be ripe but not dry, as feeble plants alike result from insufficiently ripe and from over-ripe nuts. The coconut does not come true to seed; indeed, it would be difficult to find, in any field, two trees bearing nuts that are exactly alike, in colour, size and thickness of husk; but there is a better chance of getting a good type from a good tree than from taking seed indiscriminatingly. The ground for the nursery should be dug six inches deep, and formed into beds four feet wide, by removing three inches of the soil and laying it on the intervening spaces; then pack the nuts as close as possible, in the beds, with the stalk-end up and return the earth dug out, to fill the spaces between them, cover the beds with straw or grass, and water, when there are four or five days without rain.

LINING.—The clearing should be completed by the end of February, and the lining and holing begun with the first March rains. Experience has settled 25 by 25 feet as the proper distant. Great care should be taken in lining, not that a foot or two one way or another will affect the ultimate crops, but no one with good taste can wish to leave behind him a lasting memorial of careless work when a little more trouble will record his skill for a century.

HOLING.—Coconut holes cannot be made *too large*, say 3 by 3 by 3 feet, and they should be filled in for half their depth, with soil from the surrounding surface. It is important to give the plant

the means of a fair start, and 18 inches of loose rich soil, below and all round it, is the best availabe means to that end; indeed a plant so treated will gain several years on one placed in a one-foot hole.

FENCING.—The next operation, or rather an earlier one, is a fence sufficient to keep out cattle. There is generally enough of wood on the ground to form a strong rough fence that will serve the purpose for three years, and the planting of a live-fence may be deferred till that begins to fail or till there is leisure to attend to it. There are many plants that may be used for fencing, but that in most common use is *erandu*, the efficiency of which depends entirely on the maintenance of cross-sticks tied to each plant, and that requires to be renewed, at considerable expense, at least once a year. Sapan is straggling and unreliable, and is given to resentment when any attempt is made to train it. The *bide-a-wee* thorn would make an excellent fence, but I am not aware that it has ever been tried, or even that it will submit to training, more than to external meddling. The kaju makes a very effective fence, in the Kadirana cinnamon estates, but like all other live fences, it needs training and labour to keep it in order. The fact is that plants in great variety may be trained into a good fence, but all require labour and care.

SECONDARY CROPS AND GOIYAS.—I have no objection to growing secondary crops on a young coconut field; but the value of the crops should cover the cost of labour at current rates, restore (in the shape of manure) the fertility they take out of the land, and yield the owner some return of profit for his time and trouble. Those conditions are not met by the usual goiya course—kurakkan, cassava and sweet potatoes. These products have only a local value, and are only used by the poorest of a poor population. The kurakkan crop is the most exhausting that can be taken off land, consuming more of the nitrates and phosphates than many other products of much greater value would do; and if cassava and sweet potatoes are less detrimental to the soil, their money-value is hardly worth cultivating. By the employment of goiyas, the land-owner saves the payment of felling and clearing his land, under R10 per acre on the average; he receives a few rupees per acre as the land-share of the crops, and he need be nothing out on account of cultivation for the first two years, and all that he gets will seldom aggregate R30 per acre

Per contra, he loses an unknown measure of the freshness and fertility of his soil, which, because it is unknown, he never counts ; yet it is a real element in the account. Were I interested in the question, I would submit a sample of kurakkan to a chemist and thus ascertain the money-value of the elements it removes, but, as I am not, and never intend to be, I am not prepared to go to the expense. It would be more tolerant of goiya cultivation if they would grow some other crop than than the everlasting kurakkan. Dry chillies, for instance, are worth R25 per cwt. and average jungle soil will certainly yield 3 cwt., most probably more, whereas the money-value of the best kurakkan crop is under R30 per acre. If the proprietor starts his estate with capital enough to do his cultivation full justice, there are many ways in which this can be done with greater profit than employing goiyas.

Secondary Crops and Alternative Treatment.—As secondary crops, such products as croton and anatto would be much more profitable than goiya culture ; the former sells at 70s to 80s in the London market, and I believe there is always a paying market for the latter, though I found no quotation in the *T. A.* In fact there are many things that could be grown with profit on the land, and with small injury to the coconuts, during the long years the cultivator has to wait ; and if some of the profit be expended in fertilisers for the secondary crops, the coconut will partake. The only thing to be avoided in such case is growing anything running up to shade the coconuts. If it is preferred to devote the whole strength of the land to the coconuts and bring them into early bearing by forcing, the best way is to sow the land with guinea-grass, stall feed as many cattle as will eat it, and keep putting the manure so made to the most feeble and lagging trees in the field. By this means the trees may be brought into heavy bearing years earlier than they would yield a nut if left unaided even by tethering cattle on the natural pasture, so that they cannot reach the young trees: and by digging in the droppings near the plants, much may be done in hastening bearing. Such operations would not, indeed, bring any fresh fertilising matter into the land, but, by concentrating such as was already there and placing it within reach of the roots, the tree would be strengthened and stimulated to push out roots more rapidly in search of further supplies of plant-food, resulting in quicker growth and earlier maturity. I would be glad to convince every owner of a young coconut property that it is more to his advantage to treat his trees generously and get them into

bearing in seven or eight years than by grudging and withholding a very moderate annual expenditure, having the trees straggling into bearing over the whole ten years between the tenth and twentieth, and that twenty acres fairly treated throughout will, at ten years' time, be a more valuable property than one hundred that has been starved and neglected. It has been sadly against a progressive improvement in the cultivation of coconuts that the proprietors are almost to a man traders, clerks and professional men who have thus invested their savings, but who acquire no knowledge of the habits and requirements of the plant.

ENEMIES OF COCONUTS: WILD PIGS.—If there are wild pigs in the neighbourhood of newly-planted coconuts, they are very destructive, and I know no effectual means of circumventing them. A secure fence would do, but I have never seen a sufficiently secure fence. Night-watching is of little use in dark nights, while battue-hunting is not easily organised, and is seldom if ever effectual in either exterminating or driving the herd away from the locality. This danger is, however, passing away as the country is opened, though the herds often linger in their old haunts as long as they have cover. It is only within the first six or eight months that the plants are liable to this evil.

WHITE ANTS.—White ants are very destructive to young plants for the first year or till the roots have so far penetrated the soil that the plant is independent of the nourishment derived from the husk. Many things have been tried as remedies with more or less success but the only thing that effectually settles them is arsenic. The difficulty is in the application of the minute quantity necessary: half-an-ounce of arsenic would poison all the termites in a a hundred acres if they could be induced to partake of it. From Queensland we are told that a paste of flour, sugar and a small quantity of arsenic distributed about their nests will clear a whole neighbourhood. No doubt the smallest atom of the poison will suffice for a single ant if it can be induced to take it. This information was accompanied with a piece of natural history that, if true, would render dealing with this pest extremely simple. It is maintained that white ants eat the dead, so that when you have succeeded in poisoning one, you have provided for the destruction of a thousand. I would recommend the following process in the case of coconut plants:—Take a tub, fill it nearly full with fresh water, dissolve in it a quarter of a pound of sugar to each gallon of water,

add flour till the mixture is of the consistency of whitewash, add two grains of arsenic for every gallon of water. Mix thoroughly and keep stirring while the coconuts are being dipped in the mixture. Lay the nuts in the sun to dry the thin coating of the mixture that adheres to their surface, and then plant. There is no doubt whatever that the insects will be destroyed if they eat the mixture, and it will be impossible for them to reach the coconut without doing so.

CATTLE.—Cattle eat the leaves of young coconuts, and for the first three years must be absolutely excluded, or securely tethered, out of reach of the plants. They are out of danger when the animal can no longer reach the lately-developed leaves, and they do not meddle with the older growth.

PORCUPINES.—Porcupines are not common in coconut districts; but where there is even one in the neighbourhood of coconuts that lately formed stem, it is very destructive. Its mode of operation is to eat through the stem and commence on a fresh tree on each nocturnal visit. Wherever it puts in its appearance, it should be hunted down and killed at any cost.

KURUMINIYA OR BLACK-BEETLE.—When the coconut has tolerably thriven during the first year and has any available cabbage in the heart the black-beetle commences operations. He bores his way through the outer covering of mature leaves, gorges himself on the tender undeveloped heart, and then departs till he is again an hungered when he returns and effects a fresh entrance. When he finds a tree especially to his taste, he returns so often, that, when the cut leaves come out, the foliage has a most ragged and forlorn appearance. All this work is done in the night, and he is very rarely found in the tree during the day, but, when he happens to delay his departure till daylight, he remains in his retreat all day, and if discovered, may be slain there with a barbed wire. I have lately seen kerosine oil tried, but without any effect. The insect cares not for stinks, it cares not for smoke, it cares not for anything man can do to circumvent it. The only way I know of reaching this pest is to hunt up and destroy the grub in every dung hill, every accumulation of decayed vegetable matter or rotten tree in the vicinity. A specially favourite breeding place is an old heap of cinnamon scrapings on estates, where a score of great white grubs may be found often in a cubic foot of this matter.

Red-beetle or Kandapanuwa.—The next foe that attacks the coconut is the red-beetle. Unlike the large black species, it has no alimentary apparatus whatever in its perfect state, the sole business of that stage of existence being the propagation of its species, and its breeding ground is the tender stem of the young coconut tree. It is furnished with a stiff horn in front, with which it is supposed to puncture the outer coating of the stem, and deposit one egg in every opening so made. As soon as the grub is hatched, it begins to eat its way inwards upwards, enlarging the opening as it grows till it attains its maturity as a grub. It then returns from the centre of the stem, and just within the outer rind, which it reduces to the thickness of foolscap, it wraps itself in a cocoon of the fibre of the steam and there awaits transformation; when that occurs it is easy for it to break through the thin partition that divides it from the outer air. The coconut is in danger from this insect, from the time it shows stem till it begins to bear. The body of the young stem is a mass of matter of the same nature and consistency as the heart of a cabbage stalk, which hardens from the surface inwards. Nature has provided for the protection of the tender young stem in the close fit of the imbricating leaves which enclose it on all sides, and retain their hold till they rot *in situ*. The red-beetle cannot penetrate the leaf-imbricating leaves when the older ones decay in the course of nature, the stem has become too hard for its operations. A tree here and there may be lost from an accidental wound or from some defect in the fitting of the leaf-sheaths, but it is only where the good taste of the planter has impelled him to trim the leaves that any serious damage has been done to a field. All the leaves should be left on the tree till Nature disposes of them at her own time and in her own way. Nothing that can be done to a coconut tree above the ground can be anything but injurious. As soon as it is discovered that the *kandapanuwa* has effected an entrance, the tree should at once be rooted out, chopped up and burned, as there is no more hope for it, and it is not well to leave a breeding ground for so formidable a foe.

Rats.—When an estate is in bearing, it often becomes infested with rats. They attack the half-grown nuts, make a hole through the husk and shell, and, when they find a tree with fruit to their taste, they appropriate its whole produce. The native cultivators put a ring of tar round the stems, which they say is too smooth to give them a foot-hold in climbing, and they sometimes keep a donkey

in a field, whose braying is supposed to frighten them to the extent of driving them out of hearing of the awful sound. The tar dodge may possibly be effective, but the trees should all be cleared of rats in the first place; every tree in the field should be tarred and all other means of getting up removed, for they can freely pass from tree to tree, and, when they have sufficent food and drink and the materials of a comfortable nest on the spot, thy have no occasion to visit *terra firma*. As for donkey braying, it is probably one of the myths to be found in the folklore of every land. It is a misfortune of the coconut planter that all his foes are nocturnal in their habits, so that in dealing with them he gropes in the dark. Would the rat only come out and work in the day, the infected trees could be watched and a charge of sparrow-shot bestowed on the robbers. Attempts have been made to poison them, but, while they have their will of the young coconuts, the most savoury morsel will not tempt them.

LOCUSTS.—The locust is so rare in Ceylon that it is hardly worth mentioning, but they sometimes appear in small numbers, and the coconut-leaf is a favourite. They devour all the leaflets, leaving the bare midribs, so that, when they have done with it, it has a very wintry look.

GRATITUDE OF THE COCONUT FOR FERTILIZING MATTER.—On all soils, except the most fertile, the presence of a human habitation in a coconut field can always be distinguished at a distance by the superior height and luxuriance of the trees that surround it. The native accounts for this appearance by saying that the coconut loves the sound of the human voice. This is on a par with the old theory of the water rising in the pump because nature abhorred a vacuum, which held its ground till it was discovered that nature's abhorrence of a vacuum was only thirty-two feet deep. The bulk of the Sinhalese people have not yet discovered that whistling-jigs to a millstone would be quite as useful as singing the gems of vocal music to a coconut tree. The true cause of the better thriving of the trees round a dwelling is natural manuring. Where a family and their usual stock of domestic animals reside, there are daily droppings of fertilizing matter within the circle they frequent, decreasing from the centre outwards. The trees nearest the house are always in bearing years before the out field, and they always continue the most productive throughout, or as long as the house remains inhabited. Put a set of lines in the most backward part of a field, and improvement

begins at once. This proves the gratitude of the coconut for any help, however small, that either by accident or design is given to it, and suggests hastening the profitable period by artificial means. On most places, a few trees near the house flower in the sixth year, some even in the fifth, and yield a fair crop in the eighth, whereas those that have had no manure do not begin before the tenth year and struggle into bearing, one by one, up to the twentieth, while the best that the natural soil can do is not attained before the twenty-fifth. There is not within my experience any other plant that so quickly and fully responds to fertilizers and much or little the result is proportionate. If one tree favourably situated can bear a crop in the seventh year, a whole field may be made to do the same, the question being: "Will it pay?" To answer this question the cost of opening a coconut field must be analysed.

NATIVE PRACTICES: CALCULATIONS OF COST.—By goiyas, the field will be cleared without money spent; and in a very favourable case the land-share of the secondary crops will cover the cost of lining, holing and planting and the owner take over his field free of all cost to him, except the fee simple of the land, and the accumulated interest on it. The field is then left to grow up in jungle for three years, when there is the alternative of clearing the jungle or letting it grow on, and finally smother 90 per cent of the plants, whereas the reclearing of the jungle, if done in the sixth year, will probably save 50 per cent. The field may then be left till the most forward trees begin to flower, say in the twelfth or thirteenth year, when the final clearing takes place; and in favourable cases 40 per cent of the trees will be alive, and 10 per cent of the these in bearing, the remainder being of all sizes downwards, in the event of steady cultivation being then carried out, in keeping down the jungle and replanting the vacancies. The annual expense per acre will be R12, and only about the twentieth year will the field be yielding enough to cover its annual cost, while 10 per cent of vacancies will still exist. Thus the absolute cost in money of bringing coconuts into bearing, in the most slovenly and desultory manner, will be R120, R30 of which will be recouped by produce up to the twentieth year.

EFFECTS OF LANTANA.—I have assumed that the land dealt with is of average quality, and that the indigenous jungle alone has to be treated; but if lantana obtains a settlement in the third year

and is left untouched for the next three, not one coconut plant will survive till the seventh year. When lantana gets into a clearing, it thoroughly masters and keeps down every other growth that it overshades, but any tree that has got above its usual range of seven or eight feet is safe from being smothered. However, its growth may be retarted by the struggle to obtain food in the soil against such an active and greedy foe. The presence of lantana in a clearing guarantees the extermination of every other member of the vegetable kingdom that depends on the first eight feet in space for its air, light and sunshine.* It has rather bothered the old school coconut planters.

CALCULATIONS OF PROCEEDS.—The chances are that under the above system the yield of average soil will be 1,000 nuts per acre, worth (say) R30. There is R90 to make good, the interest on which, at 10 per cent, is R9; the current expenditure is R12, and there is R9 over to be deducted, if we value the proceeds at R30. Supposing the annual increase of proceeds to be R5, it will take 5 years to rub out the R90 that stood at debit in the twentieth year. Thus in the twenty-fifth year the place is clear, and the annual average income per acre will be thenceforth R38 per acre, so long as the price keeps up to R30 per 1,000, and this calculation drops all the back interest on the original cost as well as on current expenditure, from the twelfth to the twentieth year, which, if taken into account, would leave from R60 to R70 to be made up before the property was thoroughly clear of debt. This is by no means a fancy sketch, but almost the exact history of more than one property that I have had under my own observation during the whole course of their existence.

ANOTHER SKETCH.—I will now give another sketch of what happened on the adjoining lot to one of the properties described above. The land was felled, cleared and planted, but the jungle got up again so rapidly, that, at the end of twelve months, it was 10 feet high, and the wild pigs have done "their worst" with the plants—only four plants remained in the whole field. This was rather discouraging, but the proprietor has a good deal of latent pluck, and the second year went to work on a new plan. The jungle was regularly rooted out, at a cost of R20 per acre, and planted with cassava, to which the pigs more earnestly inclined than to the coconut plants, and about 70 per cent were got out of this danger. The vacancies were regularly supplied twice a year, but at the end of nine years they still amounted

* "The survival of the fittest."—ED.

to 10 per cent. The meantime continual war was made against jungle and lantana, and when the trees were four years old, the pasture grass was mid-leg deep. Cattle were then introduced, but, as many of the plants were not out of danger, they were tethered out of reach and shifted as required. Before the end of the fifth year 10 per cent of the plants were in flower and three-fourths of all that had been treated with cattle-manure were in bearing before the ninth. Further deponent sayeth not, as the ninth year is not yet ended. The trees that began on flower three years ago have now crops of from 50 to 150 nuts; allowing for all accidents, they will average 80 per tree, or 5,600 per acre, which at R30 gross produce R180. I think the proprietor would have refused me his permission to tell in Negombo and publish in the street of Colombo that he had expended about R200 per acre on coconuts before obtaining any appreciable return It would have blasted his character as a prudent and intelligent person for ever, unless accompanied by the further fact that every penny principal and interest would be returned before the twelfth year, leaving a very valuable property in his hands, The only thing that has been brought into his property by way of manure was one-third of a ton of quicklime, at a cost of R7·50 per acre. As everything done of this property was experimental, the expense would be very considerably reduced by the knowledge acquired of what to do and how and when to do it. It may be added that the land in question is very much above an average quality, which, if favourable to results, greatly enhanced the cost. There is a portion of this property that has never got any cattle-manure, but in every other respect the treatment has been the same, and there is no outward difference in the soil; yet there is a marked difference in the trees, no one of them being in bearing and many not even so advanced as to show stem. As their wants cannot be supplied from internal resources, the proprietor states that he will give each of them 12 cents worth of poonac at once and repeat the dose yearly till uniformity is attained.

How an Old Estate was Treated and How it Responded.—Having thus told what has been done in hastening the maturity of young coconuts in good soil by manure made on the spot from the natural produce of the very land on which the plants stand, I proceed to relate what was done with trees twenty-one years old on very poor sand. The estate in question at twenty-one years old yielded a crop averaging 13½ nuts per tree, and that was the largest it had ever given. The copperah was worked

up on the place; there was a large stock of half-starved cattle, and a stock of pigs were kept: but all this had got the crops no further than $13\frac{1}{2}$ nuts per tree. At this stage, a new manager took charge, and, after due study of the situation, he submitted a scheme that added about 10 per cent to the average annual expenditure. Some of the points were strongly opposed by the agent, but, being a reasonable man, he finally gave in to the reasons adduced and sanctioned the complete plan. The pigs were got rid of, as their local value was then only about 25c. a stone dead weight; one-third of the cattle stock was sold off by auction without reserve; the whole remaining stock were allowed the liberty of the poonac tubs, and a shed was constructed roomy enough to hold the whole comfortably. There were extensive "deniyas" on the property overgrown with panferns and coarse grass, and four boys were sent with small single bullock-carts to cut and bring this stuff to the cattle shed, and spread it over all. Thus in the course of six months there was a depth of from two to three feet of excellent manure. At the opening of the monsoon rains, the cattle were moved to a fresh shed, and the manure carted out and laid down at the rate of two and a half cubic feet to each tree; it was then scattered equally over the surface and dug in with mamoties. The improvement of the trees and the increase of crop that followed this treatment was marvellous. All the manure that could be made on the estate, however, was a mere drop in the bucket; such a manuring only told on three crops, while it would have taken 12 years to go over the estate. Still even this was sufficient to cause a steady annual increase of crops from $13\frac{1}{2}$ up to 21 in six years. After some trouble, permission was granted to try steamed bones, and in the six years one ton was used with such satisfactory results, that two tons per annum were allowed for the next four years, with the result of $33\frac{1}{3}$ nuts per tree in the eleventh year. Shortly afterwards this estate was sold to natives, and six years later the crops were said to have fallen off to 12 nuts per tree. The whole cost of manuring during those ten years aggregated R1 per tree and the value of something over R3 thus recovered giving a return of 300 per cent on the outlay in four years, and there is not the least doubt that five times the amount expended within the same time would have given equally satisfactory results.

THE COCONUT TREE A CHEMICAL APPARATUS.—I look on a coconut tree as a chemical apparatus, for turning carbon, oxygen and

hydrogen into oil. Those elements are not counted in estimating the fertility of soils; indeed it is probable that plants derive their whole supply from air and water. If this is admitted, it follows that no quantity of oil removed from a given area of land in any way tends to impoverish the soil. But the coconut tree cannot make oil without a proportion of other elements that it combines; the process requires nitrates, phosphates and alkalies, to complete the operation, and these it must obtain from the soil. Extract the oil and return all the other products of the tree to the soil it occupies, and there will be no diminution of the average yield of oil, as long as the tree lives in health. Increase the supply of nitrates, phosphates and alkalies in the soil, and in due proportion the tree will produce more oil, while the fertilizers introduced are a permanent gain.

Replacing Fertility Removed; Poonac as Manure.—The coconut planter, who desires to maintain the average crops of his property, will do well to ascertain the average of the fertilizing elements removed in a given number of nuts, and set aside such proportion of the price as will replace them. The sure way is to manufacture his oil on the spot and retain the poonac; but sometimes it appears more profitable to sell the nuts as they stand than to extract the oil and sell it separately, because the cost of manufacture, with a primitive apparatus he must employ, is greater than with proper machinery; but if he knows exactly how much nitrates, phosphates and alkalies are in a candy of copperah, and their prices, he will know how to proceed in his purchase of fertilizers so as to maintain or improve the condition of his land. There may be better forms of fertilizer than poonac, but 140 lb. of poonac will, as a rule, restore all that is carried away in 1,000 nuts; and when this quantity can be obtained for R1·25, there is no cheaper way of giving back what is taken away; besides, it has an advantage over every other form of manure in supplying all the elements of the coconut in the exact proportions required, while the loss, by putting it through the alimentary apparatus of a cow, is very small.

Manure Made from the Coconut Field; Manuring should begin early.—Manure made by cattle fed on the grass of the coconut field adds nothing to the general fertility of the land: it merely removes it from one place to another; but while the plant is young, and only commands with its roots a small proportion

of the space assigned to it, the placing of it within reach of the roots in this form is of high importance to its rapid growth and early bearing. It is not the amount of food thus placed within its reach that limits the good done, the roots are stimulated to push out further into the soil, and thus acquire a wider feeding-ground. Small doses frequently repeated are far more beneficial than greater quantities at long intervals; and in every case it should be buried under at least two inches of soil. I would recommend, in putting out the plants, to dust a couple of handfuls of quicklime into and round the hole, and I would give each at the same 1 lb. of poonac. A good start is half the battle, and what is once gained should never be lost for want of a little stimulant. I cannot expect the tree to yield me an annual revenue of from two to three rupees, unless I use every means in my power to establish its constitution; and in the whole range of vegetation. I believe, there is no plant that will do so much for itself with so little help. I would spend 50 cents per tree in building it up during the first seven years, after which time it will give a return within four years of three nuts for every 5 cents worth of manure given. There is no practical limit to the yield; I have known one tree that for a series of years bore 400 nuts; I saw another a few days ago that was very little behind it, and I have known many individual trees that regularly yielded from 200 to 300, In such cases there is, no doubt, much in the individuality of the tree and special suitability of the soil; but my contention is that any tree that bears a small crop in any soil; may be made to bear a large one, the only difference being that a good soil gives a good crop without assistance, while a poor one gives a poor return, but the one will respond to manure as readily as the other. The same amount of manure will result in the same addition to the crops, whether the trees to which it is administered have previously been bearing ten nuts or fifty per annum. The weaker tree may appropriate some part of the manure to build up its strength, and, if the soil it occupies be deficient in the capacity of retaining moisture, it may be unable to appropriate at once the food within its reach, but the manure once in the soil will tell sooner or later.

Register of Treatment by the Coconut Stem: Treatment of a Single Tree and Result.—The stem of a coconut tree on poor land forms a complete register of the periods at which manure has been administered, the effects it produced and the time

during which it operated and became exhausted. It contracts under the pressure of want, expands when fed liberally, and again contracts when all the food is used up. There was a tree that had stood for twenty-five years on sand so poor, that not a blade of vegetation was ever seen within twenty feet of it; the stem, over one foot in diameter at the surface, gradually diminished upwards, till at the five feet of height attained, it was less than four inches and the length of the leaves was about thirty inches. In very truth, no more wretched specimen of a still living plant could have been conceived by the mind of man, and it was only for the sake of proving the theory that its treatment was undertaken. Twenty pounds of poonac and five pounds of steamed bones were mixed and sown broadcast in a circle twelve feet in diameter and dug in. It began to grow vigorously at once, and each fresh leaf that expanded was an increase on the length of its immediate predecessor till at the end of twelve months they reached 15 feet; at eighteen months it produced its first flower and was again manured with five pounds of poonac and two pounds of bones; at thirty months it began to give crop, and the top was so heavy that there appeared some danger the small part of the stem giving way, but this did not happen and for the three succeeding years the same dose of poonac and bones were given. At the end of the fifth year it was a handsome vigorous tree with the stem immediately under the leaves over one foot in diameter with a crop of from 60 to 70 nuts, while the aggregate of previous gatherings was over one hundred nuts. I have only to add that the cost of these results was 75 cents.

Confidence of Some Ignorant People and Assertion of Scientific Truth.—I felt much hesitation before deciding to tell this story as there are hundreds of men in Ceylon who consider themselves no mean authorities on coconut culture who will without further ado pronounce it an absurd impossibility. There are truths that science has made common property, but which few coconut planters have yet asserted their right in, or indeed become aware of their existence. How few of them know that 187 lb. of poonac contains all the elements there are removed from the soil in a candy of copperah (560 lb.)? How few of them know that the poorest soil may contain some of the elements of fertility that the plant cannot assimilate from the absence or deficiency of other necessary elements? How few of them know that a very slight dressing of the deficient elements will

produce immediate and abundant effect. A few measures of quicklime may bring into activity a great fund of latent fertility; a few ounces of bone-dust may be the one thing wanted in the soil to put a good crop on a barren tree.

GOIYAS AND AGRICULTURAL SCIENCE.—Were the principle of agricultural chemistry explained to a Sinhalese goiya, he would pronounce it a myth and his informant a humbug; but ascribe any special success to having entered into communication with a beneficent demon who for certain considerations came every night to bless the trees, he would firmly believe the statement, and from thenceforth would display an increased respect for the recipient of supernatural favour. As such men have really been the practical creators of the coconut industry in Ceylon, and really knew more of the matter than those who purchased the land, there is nothing surprising in the fact that scientific treatment has not progressed with the breadth of cultivation, and not much can be expected in this direction till the agricultural school begins to turn its graduates loose on society. There are not half-a-score of Europeans that know anything of, and hardly one-half of that number who retain a practical hold on, coconuts. There are no doubt many educated and intelligent proprietors, but very few of these are practical planters, and not one that I have come across will deign to look on the scientific aspect of the culture. I have often heard it laid down as an incontrovertible rule that no coconut should be manured before it came into bearing. I invariably found that the parties asserting it had never tried it. A few weeks ago a party who was not a planter warned me against the practice. I told him that he ought to have dismissed that prejudice with his konde and his comboy for it was utterly at variance with a short crop and a pair of tweed trousers.

W. B. L.

SOME FACTS AND OPINIONS ABOUT COCONUT CULTIVATION.

(*Written in December 1897, by the late Mr. W. B. Lamont, a very experienced Ceylon Coconut Planter.*)

CLIMATE, TEMPERATURE AND RAINFALL.—The coconut is essentially a tropical plant. It cannot be profitably cultivated in an average temperature much under 80°. On deep rich soil it will thrive on an annual rainfall, perhaps, as low as 40 inches; but in the Southern and Western Provinces of Ceylon, which contain at

least three-fifths of all the coconuts in the Island, the soil is, as a rule, poor: the coconut needs 70 inches and upwards, but in districts, with 100 inches or upwards, it is apt to run more to leaf than fruit.

ALLUVIUM.—Alluvial flats by the side of the larger rivers, subject to occasional flooding, are beyond all comparison the most fertile in the Island. It is hard to get coconuts up in such spots, from the rapid and luxurious growth of indigenous plants; but once thoroughly established and in bearing, I am afraid to mention the amount of their annual crops, lest I should be accused of exaggeration, by those who have had no experience of such yields. Such sports are of rare occurrence, and seldom of large extent; but ten acres of such land fully planted and in bearing is worth fifty of the next best.

SAND.—Loving sand, with a good percentage of organic matter, is the second quality, but it is almost as rare in the Southern and Western Provinces, as the first; but by skilful cultivation, it may be brought up to a yield little inferior to the alluvium: the difference being that the great natural fertility of the latter requires only the minimum of trouble and expense, whereas the former requires much of both. The fertility of the one is inexhaustible, that of the latter fails from lapse of time and neglect of cultivation.

BROWN LOAM.—The soil, third in order of suitability for coconut cultivation, is the brown crumbly loam, rare in the South-West, but common in the North-West as far inland as the temperature and rainfall is suitable. It is very fertile, but not exhaustible; and it responds less freely to cultivation and manure than the sandy loam.

GRAVELLY LOAM.—The soil fourth in order is gravelly loam, somewhat stiff and hard, but fairly fertile.

CLAYEY LOAM.--The fifth is clayey loam which, though richer than some of the other mentioned, is, in districts subject to long spells of dry weather, very trying to the plants which sometimes suffer fearfully. This kind of soil yields up its moisture very rapidly, and after a three months' drought, gets as hard and dry as brick, to the depth of two feet. In rainy weather the plants grow vigorously, but they often lose, as much in the dry, as they gain in the wet-season. Such trees, however, as get their roots down into the soil, beyond the reach of drought, generally bear heavy crops; but it is risky to plant such land. It is deplorable to see trees of ten to fifteen years' standing, dropping bunch after bunch of a heavy crop, and having the greater part of the leaves hanging withered about the stem.

LOAMY GRAVEL.—The sixth quality of soil is the loamy gravel, or rather the gravelly loam—that is to say, when the loam is in excess of the gravel, though seldom very rich, it is fairly fertile and very readily responds to breaking up and manuring.

QUALITY OF SOIL DEPENDENT ON ROCK.—The mechanical constituents of all soils are loam, sand and gravel, with various proportions of organic matter; but each class grades down: light friable loam to stiff impermeable clay; sands grade to such as we see on the seashore, and gravels into pure stones and sand. The quality of soils are governed by the composition of the rock from which they are derived—in some kinds clay predominates; in others sand, and in some gravel. Then some may be rich in potash, others in lime, in magnesia, in phosphate, and some in all these and other elements that more or less affect fertility. It is, therefore, important to know something about geology in choosing land for coconut cultivation.

VARIETIES.—The coconut sports into so many varieties that in any hundred trees in a field hardly any two of them will be found producing precisely similar fruit in size, form and colour: in size they vary from one to two feet in girth, in form from nearly globular to various degrees of oblong, and in colour from bright green to yellowish brown and in the case of the king coconut to bright yellow. They differ in the prominence of the ridges of the husk, and in the thickness of both husk and kernel. They differ in the length of the leaf-stalk between the stem and the beginning of the leaflets, and they differ in the length of the flower-stalks.

SELECTION OF SEED NUTS.—Amid all this sporting, it is beyond hope to get a single variety for a whole field, but a good progeny may be fairly expected, and a good percentage, therefore, of seed nuts should be taken from select trees. Such a tree should be free of growth and strong in all their members, an early and heavy bearer, carrying its fruit on short stalks. The fruit should be of medium size, oblong in form, thin in husk and thick in kernel, gathered when fully ripe, but not dry.

MEDIUM SIZE RECOMMENDED.—The largest nuts are usually produced on strong healthy trees, but the numbers are small, the husks thick and the kernels comparatively thin; whereas the medium size gain more in number than they lose in size: the husks are thinner and, as a rule, the smaller the nut the thicker the kernel. I remember two trees, next each other in a line: one bore very large nuts, but its

annual crop never reached 30, while its neighbour with very small nuts bore annual crops up to 300 and the weight of copra was four times that of the former. Medium-sized nuts are in all cases to be preferred—not that the fruit of any given tree will produce a copy of its parent, but the chances are that the variety, though better or worse, will not very materially differ.

There may be some more trouble, expense and inconvenience, in selecting trees for seed nut than in picking single nuts from a heap; but the advantages far more than compensate these objections: a bunch of ripe nuts is due every month, but it is the custom to pluck only once in two months, as it saves labour. Nuts cannot be too ripe for copra making; they may be too ripe for seed; while the second month's bunch may not be ripe enough. In selecting nuts from a heap so gathered, there can be no uniformity in their degree of ripeness. Thus, in a nursery so formed, there will be months of difference in the time they take to germinate: a large percentage will be weak and late, and slow growing plants; and another considerable percentage will not germinate at all. If the bunches from the selected trees be plucked at the proper stage of ripeness, each month they will be more uniform as to time of germinating and in their subsequent rate of growth, both in the nursery and the field; while of feeble, worthless plants and non-germinating nuts there will be few if any.

NURSERY.—The nursery ground should be as nearly level as other circumstances will admit of; it should be near water, as that may be needed in dry weather; it should be trenched 18 inches deep. The nuts should be placed with the stalk end up, which enables the shoot to come up vertically from one or other of the three eyes of the shell; whereas, if laid on its side, it has to turn at right angles, to attain that position on emerging from the husk. The nuts should be buried in the loose earth to within two to three inches of the top; is the purpose is to put out the plants in the field, when they have four leaves, they need not be placed more than two or three inchef apart, but if they are meant to be larger, when removed, they should be given proportionately more room.

CLEARING.—I can suggest no improvement on the plan of preparing jungle land for cultivation, namely cutting down and burning off. I believe the attempt has been made to line and hole, through standing forest; but I cannot see sufficient advantage in doing so, to compensate the additional toil and expenses.

CLEARING BY GOIYAS.—I believe that ever since coconuts began to be regularly planted in the Western and Southern Provinces, the custom has prevailed of letting the land out to goiyas, to be cropped with fine grains (chiefly kurakkan), roots and vegetables, the land share being one-third of the produce by way of rent. The goiyas cleared and cultivated the land till it ceased to pay them. The owner provided plants and paid the goiyas one fanam for holing and planting. In most cases the land owner looked for his profit in the land share of the goiyas' crops, rather than in the far away crops of coconuts; therefore where the surface fertility was exhausted, the coconuts were left to nature, and nature set vigorously to work to blot them out of existence. This is the history of many thousands of acres; and then I have known land that at a very moderate cost would have yielded 3,000 nuts by the tenth year, cleared, cropped and replanted three times in twenty years. Large tracts of land have thus been permanently impoverished, because the native land owner prefers paying for work done out of the fund of fertility in the soil than in hard cash: he can handle and count and fondle the latter, while the former is an unkown quantity that will bear being drawn on to any extent.

GOIYAS' WORK.—The wiser plan is to pay cash for work done at current rates and reserve all the fertility of the soil for the permanent cultivation. The goiya knows well how to take the fertility out of the soil—the first year he plants cassava and sweet potatoes, and over these sows kurakkan: this latter allows nothing else to grow while it occupies the ground, but as soon as it is reaped, the cassava takes a start, and is the crop of the second year; the sweet potato has then its nursings and is the crop of the third year. By this time the freshness is pretty well taken out of the soil, but if it be unusually rich, a second crop of kurakkan is taken.

LINING.—The first thing to be done, after clearing the land, is lining. In fine soil 30 ft. by 30 ft. is not too wide; but in no case should the plants be closer than 25 ft. by 25 ft. The easiest way of doing the work is to get a base by the road tracer and the parallel lines by the compass. It is the usual thing to plant in squares, but there is some advantage gained by planting in triangles. Planted at say 25 feet in squares, each plant will be equi-distant from four others; but with the lines 25 feet apart, the diagonal line will be over 30 feet. In triangles, the distance of all plants to the nearest in adjacent line will be 30 feet and fraction. In the square of 25 feet, the leaves of adjacent trees will cross from four to six feet;

but in the diagonals, there will be space that the leaves of opposite plants do not reach, whereas in triangles that space is reduced from 35 to 30 feet.

HOLING.—Coconut holes *cannot be too deep or too wide*, but as they must be kept within practical lines, let us say three feet cubes. These should be filled in to half their depth with surface soil; and the plant placed in the centre with the crown of the nut at least 15 inches below the general surface, buried to the same depth as in the nursery.

TREATMENT OF PLANTS UP TO FOURTH YEAR.—As young plants at from 25 to 30 feet apart cannot for years avail themselves of all the space allotted to them, and as to keep all that space clear, through all these years, would be not only expensive, but very injurious to the soil, the best thing to do is to let the jungle grow. By this means, the soil will be protected, from the alternations of heavy rains and burning sunshine. The only work required for four or five years is to keep a clear circle round each plant, and widening them as the roots and leaves extend, by eradicating the jungle and breaking up the surface soil; at the same time the holes should be filled in gradually, an inch every three months or so during the first year and a little more during the second. When the plant carries ten green leaves, it should be brought to the level of the surface. By this process, the freshness of the soil will be reserved, for the use of the cultivated plant, and the last of the jungle will disappear, as the leaves meet across the lines. Treated thus, the earliest tree will flower in the fifth year and the whole field should be in bearing from the eighth to the tenth year. By the fifth or sixth year, the jungle will be all disposed of, and it only remains to keep the surface soil well broken up and exposed to the action of the air.

PLOUGHING.—This has been tried by the plough: but, in my experience, I have not seen it succeed. The native plough drawn by a pair of buffaloes needs one man to drive and another to hold: it scratches the surface to the depth of three inches or thereabouts, the furrows crossing each other at all sorts of angles, and sometimes two feet apart. Such an operation does little or no good, and is a little less costly than a proper turning over with the mamoty. Ploughing should be deferred till a suitable instrument can be obtained, and a trained ploughman who not only knows how to hold the plough, but can train his cattle to walk straight. A mamoty digging once in two years will suffice in the way of cultivation.

TIMES OF APPLYING MANURE.—Except to stimulate a lagging plant, manure should not be applied to young trees. A field should be allowed to demonstrate what the soil can do for it before attempting to force it. The trees may be very strong, but late of coming into flower; and when they do bear the amount of crop may be disappointing, or they may take on more crop than they have strength for, and drop a large percentage of it at different stages of growth. The first case calls for phosphates. the second for nitrates, and if neither the trees nor their crops are satisfactory.

KINDS OF MANURE NEEDED.—The two kinds may be exhibited at once. If after keeping the surface well broken up and a supply of nitrates and phosphates has been applied, the trees do not behave satisfactorily, a deficiency of some of the mineral elements is indicated and should be supplied in some form; especially something rich in potash, but the coconut seldom suffers from the lack of the mineral elements.

NEED OF MANURING.—Not even the richest soils hold an unlimited supply of the elements of fertility, if brought under cultivation; and if some parts of their products be constantly removed in the course of years or ages, the supply must fail and barrenness ensue. When, therefore, in the course of continuous cultivation, the crops regularly diminish in bulk, it is a warning to the cultivator to set about supplying the required elements. If he knows and believes in this theory, he will not wait till his cultivated plant seriously suffers from famine, but will begin to feed it when the first symptom of hunger appears; nay, he will be the wiser man, if in the case of the coconut, he will supplement the natural supply of food, before any sign of failing crops appear, because to augment its resources with immediately available food will in due porportion increase the crops.

EFFECTS OF MANURES.—Indeed the careful application of manure, in such quality and quantity, at stated times, will double, treble and quadruple the crops of land left to the care of nature.

CATTLE MANURE.—As stated already nitrates and phosphates are the chief manurial elements required by the coconut, and the dung of domestic animals, either pure or mixed with practically decomposed organic matter, contains these and all the other necessary elements, in due proporti n. But where is the owner of an extensive coconut property to find enough of this valuable stuff to keep up, not to say improve, the crop? I once knew a property that had no pasture outside of the coconut field, but

cattle enough were kept without overstocking to eat all the grass that grew on the land; they had moreover the liberty of the poonac tub. From a considerable extent of low swampy land that produced ferns and coarse grasses, a large quantity of which was put into the cattle sheds daily, it took twelve years to give every tree on the estate 5 cwt. of cattle shed manure. It was a light sandy soil, the kind that most readily responds to manure, and the effect was immediate and marvellous: it only acted for three years, and to keep up the improvement, required a like dose every three years.

CATTLE KEEPING.—There is nothing more certain than that (except for draught or dairy purposes) the breeding and feeding of cattle is not a profitable enterprise and under any condition it is doubtful if the keeping of stock, for the sole object of making manure, will pay: certainly not, if fed on cultivated grass or purchased food. In the case of a coconut field, with no pasture outside its bounds, the keeping of cattle, beyond what is necessary for working and dairy purposes, can only be done at a loss. Cattle do no not create the elements of fertility: they only concentrate; and when removed by sale or otherwise, they carry off such part of the fertility of the soil they fed on as has gone to the building up of their bodies. It is better, therefore, to turn the herbage into the soil on the spot where it grows, than to expend a larger sum than this would cost in housing, herding, transport of manure, &c.. for no better purpose than robbing one part of the land to feed another. Of course, an estate that has the run of pasturage outside the coconut field may possibly keep cattle profitably. It is hardly possible, however, to obtain from any source a sufficient supply of dung to materially increase the general yield of a coconut field.

KINDS OF MANURE.—The planter who wishes to double or treble the yield must go to market to obtain a more concentrated manure in sufficient measure. Coconut poonac applied directly to the soil should be a very efficient manure, as it contains all the elements required by the cultivated plant; but at the rate it now sells, it is probable that an equally rich material may be got at a less price: castor cake, for instance, is said to be richer in nitrates than poonac, and, as it cannot be used as a feeding stuff, is probably the cheaper article. The planter who applies castor cake and bone dust, both or either, as the case requires, will be sure to profit by the transaction; the tree is besides grateful for any readily decomposed vegetable substance that is turned into the soil, and any one that chooses can have a special manure compounded to order by any European manufacturer.

METHODS OF APPLYING MANURE.—It is still a common practice—a most slovenly and wasteful one—to tie cattle to coconut trees by way of manuring them. Immediately round the stem, the primary roots are massed closely together, and it is only at three or four feet distant that they emerge from the cluster, and each radiates outwards on its own straight line. Though these roots go down to a great depth the tree is essentially a surface feeder, and they are most numerous within a foot of the surface.

TYING CATTLE —Tying two head of cattle to the tree for ten nights, what with treading and what with the fresh urine, kill off all roots within six inches of the surface, thus depriving the tree of its wider range of feeding ground, and the immediate effect is a falling-off rather than improvement. If the dung be dug into the soil at once, the tree revives and flourishes till the supply is exhausted, when it rapidly falls off to a worse state than before the application; but the more common practice is to let it alone. As the feeding roots of plants do their work underground, dung left on the surface is so much good stuff wasted, besides (in the case of the coconut) injuring the tree by enducing it to throw out primary roots above ground, in an abortive indeavour to reach the food from above, which it cannot avail itself of irom below.

CIRCULAR TRENCHES.—Hardly more scientific is putting manure fnto circular trenches. It is true that the tree can by this method at once avail itself of the supply, but as all primary roots are served to the depth of the trench, it is cut off from its usual feeding ground, and must depend entirely on the artificial application, those cut roots having been its sole resource for drawing nourishment from the outside soil, within the depth of trench, say one foot, which is deeper than the chief feeding space of the plant. It is astonishing how far the primary roots travel in light loose soil. I once measured one washed out on the seashore fifty-three feet long. The poorer the soil these roots extend the faster and the farther.

TILLAGE OF SOILS.—With the exception of soils in which sand is the prevailing ingredient, Ceylon lowcountry soils are hard and stiff, or become so rapidly on exposure. Light loams and gravels, on being broken up to the usual tillage depth, from six to nine inches, do not resume the hard solidity of their former state; but to keep them in the proper mechanical state for the coconut roots, the operation should be repeated periodically, as nothing conduces more to the rapid growth of the plant than a loose permeable soil. Manure should only

be applied at these periodical diggings. Dung should be broken up and spread as evenly as possible over the whole surface, and such as bone dust and oil cake may be sown broadcast; and whatever kind of manure is used, it should be turned into the soil without delay.

SPREADING MANURE AND EFFECTS.—The roots of the coconut are most vigorous and active towards the extremity of the primaries and these qualities gradually diminish towards their origin on the stem, because in their outward course, they have already appropriated the cream of the soil's elemental wealth. Therefore manure in the centre between two lines of trees is more immediately effective, than within six feet of the stem even if cattle tying and circular trenches are avoided.

PROBABLE RESULTS FINANCIALLY.—Periodical digging and manuring is the proper treatment of a coconut field so far as my judgment and experience goes. As already stated, the first digging may be spread over several years, by merely extending the tilled circle round each plant, as it requires more room. On 70 trees to the acre, the cost of this first clearing and digging will not be more than R10 or R2·50 per annum, supposing it extends over four years. No subsequent digging should cost more than R7 per acre. 350 lb. of bone dust and 350 lb. of castor cake applied to an acre of trees already bearing more or less, will within four years add 4,200 nuts to the crop. Supposing the manure to cost 5 cents per pound the cost will be R35 per acre; add R7 for labour—R42 or exactly R10 per 1,000 on the increased crop. The profit will thus be the difference between the selling price per 1,000 and R10.

WHAT MAY BE EXPECTED OF PROPER TREATMENT.—The hole system consists of the regular tillage of the soil, and the periodical application of a fixed amount of suitable manure. There is no increase of crop in the first year of applying manure; but there is a considerable increase in the second, and a still greater one in the third; but in fourth there will be a falling-off from the crop of the third year. To renew the operation of digging and manuring every second year, will therefore not only maintain the highest yield reached, but increase it year by year without any practical limit. It is well-known that individual coconut trees of good jât, that have happened to grow on a spot of naturally rich soil, habitually yield from 300 to 400 nuts per annum without any cultivation. It is then an extravagant idea that a field yielding from two to three thousand nuts per acre, with little or no cultivation, may with scientific treatment be made to yield double those numbers in a few years.

WHITE ANTS.—The coconut husk is not the taste of the white ant till it has undergone some change in the direction of decay, and then only, when more desirable substances are scarce. In transplanting from the nursery to the field, all roots that have got beyond the nut, are shaved off, being of no use to the plant in its new position. It is about this time that the husk reaches the condition that suits the white ants, and if they discover it before the plant has had time to send fresh roots into the soil, they eat out the whole interior often in a single night, the consequence of which is the death of the plant, it being deprived of any medium into which to throw out roots. This is not common in newly opened forest or old chena, as this insect does not thrive under heavy shade but is frequent in planting in open land. I first became acquainted with it, in planting coconuts in the vacancies of an old cinnamon field, where I lost above 100 plants within a week. The preventive measure which I took was fairly successful: I thickened a strong solution of salt with fresh cowdung and covered the nuts with the compound.

CATTLE.—Cattle and goats are very destructive on a young coconut field, and at any cost should be kept out. It is simply impossible to get up the plants on a spot open to cattle, and strong fencing and sharp watchfulness are both necessary for their protection. They are not out of danger till they carry ten or twelve leaves, with the central ones too tall for the animals to reach.

THE COCONUT WEEVIL—KANDAPANUWA.—As soon as the tree shows stem above ground it becomes liable to the attack of the coconut beetle or weevil, an insect about an inch long with a horn in front: its colour is red with a few small black specks, and it is nocturnal in habit. It cannot penetrate the hard outer crust of a mature coconut stem, but it lies in wait for any crack or wound that it can prepare by its frontal horn, for the reception of its eggs. The substance of a young coconut stem within its outer crust is somewhat harder than that of a raw potato, and this is the food of the young grub which as soon as hatched begin to eat its course inwards and upwards, enlarging the opening as it grows, till when about two inches long it works its way toward the outside, where just under the outer crust, to which it comes so near and which is hardly thicker than a stout sheet of paper, it wraps itself in a cocoon of the more mature fibres near the surface, to abide its transformation; and when it occurs the mature insect easily sets itself free, by breaking through the thin crust that has been prepared for that purpose. Up to this

time, there may be an hundred grubs at work inside the stem, without any visible external sign of their presence. Sometimes the fall of the whole head of leaves is the first intimation that anything is the matter with it. If the first entrance has been made on any open part of the stem, the presence of the grub may be detected by the flow of a dark liquid from the opening.

By whatever means the presence of the grub may be detected, there is only one effectual means of dealing with it. Dig out the tree, chop it into fragments, and subject them to the action of fire.

When the stem forms above ground the leaves stick to it with great tenacity and persistency, and form a close imbricated cover to the still tender rind. Let no leaf therefore be cut or torn from the stem at any stage, but leave them to rot off, *in situ*, after performing their function. The weevil cannot make way through the closely-packed leaves that surround the stem, but sometimes in the case of a quick-growing tree, nourished by a rich surface soil, the stem expands into a bulb and bursts the outer leaves, while still green and strong. Of such an opening the insect is sure to avail itself. Such split leaves (always the outer ones) may be shaved off with a sharp knife, taking care not injure the stem in the process. Never search for the grubs in suspected trees, and never cut holes in the stem in the hope of saving the tree. It is better to lose a tree here and there than run the risk of losing a great many by injudicious meddling. It is some comfort to know that the whole colony remains attached to their native tree till it is thoroughly consumed, so that when dug out and burned, we destroy the whole family in all stages of existence. Till this evil has fully declared itself. judicious letting alone is best.

THE COCKCHAFER—KURUMINIYA.—Most people know the great big buzzing blundering cockchafer that getting into a lighted room dashes his head so violently against the wall. Its breeding places are dunghills and rubbish heaps, where in the pupa state it battens on its surroundings. In its perfect state it is not less voracious, but more dainty; its favourite food is the tender undeveloped leaves in the head of the coconut tree. and to it is due the ragged and clipped appearance of the leaves of trees that suit its taste. It is more than doubtful whether keeping a staff of beaters, as I have known being done, to hunt these insects in the trees, is useful. The same labour would probably be more profitably employed. in hunting the grubs in

their breeding places. There is no doubt that its operations are injurious to the tree, but happily, except in the case of a very young one, it does not kill any outright.

RATS.—Rats are very troublesome and destructive when they succeed in establishing themselves on an estate. They breed on the trees and find both food and drink in the young nuts, especially those with soft husks. They operate by cutting a hole and eating out the inside of the nut, which, of course, falls soon after. Some native planters put a band of tar round the stems which effectually prevents their climbing; but where the leaves of the adjacent trees cross, they have no difficulty in passing from one to another. Others have a firm faith in the keeping of donkeys, whose braying they affirm frightens the rodents so much that they evacuate the vicinity of such awful noise This result is more than doubtful, but the experiment is not costly I know no effectual remedy for this pest: traps and poison are useless under the circumstances.

LOCUSTS.—We are not much troubled in Ceylon with locusts, but sometimes a small troop of them attack a few trees in a field. About thirty years ago a formidable host of them appeared in and about Colombo, and especially in Captain's Garden, where they denuded the trees of all their leaflets, leaving only the bare midribs or "eckles"

LAY OF LAND.—The ideal lay of a coconut field is a slightly undulating plain, nowhere so steep that a loaded cart cannot be taken over every part of it, so as to facilitate the collection of crop. Steeper land is not to be rejected if the soil is suitable, but it does not lend itself freely to cultivation, and the collection of crop is more costly. It is not a bad plan to terrace such land, and make each tree the centre of its own platform; but it is best not to plant it if a more suitable lay be available.

CROP GATHERING.—In dealing with crop, it is the custom to gather only once in two months though one bunch is due every month. As to bunches taken on these occasions, one bunch must be riper than the other. So long as the trees are not too high to be reached by a hook on a long pole, gathering may be done monthly without any increase of cost for plucking; but when it becomes necessary to climb the trees, care should be taken that the second bunch is thoroughly ripe; the first cannot be ripe too, so it is a mere matter of time. The best way of getting the climbing done is by contract, for which Cochin men are often available. The heaviest job of work connected with securing the crop, is a work requiring both strength and skill.

Husking and Drying.—I once suggested to David Wilson a machine not for husking but for splitting the whole nut into two halves. He caught and approved of the idea, but he had at that time several other ideas to patent, that it slipped out of his mind; and I had too little confidence in it myself to carry it further.

Artificial Drying.—The more perfectly ripe the nuts are they contain the less moisture in the kernel and consequently require the less drying, and the sooner they are husked and dried after gathering the better, for the quality of the copra. To this end, every property in districts where three or four consecutive dry days cannot be depended on, should have some artificial means of quick drying, more perfect and cleanly than the rude smoke kiln in common use. Almost any mechanical engineer could furnish the plan of a chamber in which the temperature could be kept up to 200° which would complete the drying in twenty-four hours in any weather.

The View of the Average Estate Owner.—"What good," says the routine planter, "I sell my nuts at current rates, and their after-treatment is no business of mine. All this additional expense and trouble will not pay me, while they mix all qualities of copra at the mills, and produce an inferior quality of oil, giving hardly more for my superior article than for the unripe, half dried and discoloured stuff with which they mix it, especially if I have to send it to market by cart."

Remedies —There is much truth in this view of the case, but the planter may make and export the oil on his own account or he may export his copra to a better market or in some other way protect his own interests. I believe there is no other reason than a bad system of long standing, why Cochin oil should sell thirty-six per cent higher than Ceylon produce; and I believe the remedy lies with the planters themselves. It is well within their power to intercept and appropriate, at least one half, of the difference between the market value of Cochin and Ceylon oil.

General Estimates.—I leave every one who may adopt any of my recommendations to make his own estimate of cost according to local circumstances; they will cost more in one district than another, and in the hands of one man more than another.

W. B. Lamont.

Kosgalla, Ratnapura: Dec., 1897.

COCONUT PALMS

Estimated Cost of Planting and Cultivating 100 acres of Coconuts for 10 years in the Western Province of Ceylon.

Year.		R.	R.
I.	—100 acres laid at R10 and Government charges ...	1,500	
	Felling, Clearing, and Fencing	1,000	
	Holes 2½ by 2½ by 2½ 7,500 at 4 cents each	300	
	Planting	40	
	Ditches, etc.	200	
	Nursery: 10,000 nuts at R30 per 1,000	300	
	Tools and Sundries	50	
	House for Kangany	50	
	Kangany	150	
			3,590
II.	—Weeding	600	
	Nursery: 1,000 nut for supplies	30	
	Kangany	150	
			780
III.	—Weeding	600	
	Repairs, &c.	10	
	Kangany	150	
			760
IV.	—Weeding	300	
	Repairs, Fence, &c.	50	
	Kangany	150	
			500
V.	—Weeding	300	
	Repairs, Tools, &c.	10	
	Kangany	150	
			460
VI.	—Weeding	250	
	Nursery: 1,000 nuts for supplies	30	
	Kangany	150	
			430
VII.	—Weeding	250	
	Repairs and Tools	20	
	Kangany	150	
			420
VIII.	—Weeding	200	
	Kangany	150	
			350
IX.	—Weeding	200	
	Kangany	150	
			350
X.	—Weeding	200	
	Inspection and Sundries, 10 years	210	
	Kangany	150	
			500
			R8,200
	Interest—Nine years at 7 per cent ...		4,700
			R12,900

Note 1.—If given out to goiyas (native cultivators) there will be a saving of about R2,900, which will leave the nett cost of estate R10,000.

Note 2.—Crop to the value of R200 or so may be expected between close of 8th and 10th years.

Note 3.—At close of 15th year should yield from R2,000 to R2,500; at close of 20th year should yield from R3,500 to R4,000.

Note 4.—Value at close of 10th year R20,000.
Do. do. 15th do R30,000.
Do. do. 20th do R50,000.

Note 5.—Above calculations made on the supposition that the soil and climate are first-class.

PRACTICAL RESULTS OF COCONUT CULTIVATION IN CEYLON.

We were favoured some time ago with the following figures by an Estate Manager as per his books:--

FROM APRIL 1886 TO SEPTEMBER 1894.

I enclose the cost of my estate up to September, 1894. You will observe that the cost of buildings is high. The bungalow is a large and commodious and permanent one, built of brick and lime; and so are store and lines. The estate has no vacancies. I am gathering from 2,000 to 4,000 per month. I have already gathered 29,000 nuts from the trees that are coming into bearing. I get the highest price for my nuts and copperah. My salary as Superintendent is not charged in the books. The Superintendent is the man I employed before I took charge of the estate and came to reside here. The cinnamon has been rooted out and all is now planted with coconuts. My weeding to date is about 44 cents per acre per month since I commenced it. I have 275 acres, all planted, and only a small portion of it has come into bearing:--

1	Clearing	...R2,380·84	10	Manuring	...R243·87
2	Holing	... 2,091·76	11	Cattle and Sheep	...1,811·62
3	Weeding	... 10,678·77	12	Vanilla and Pepper	... 107·08
4	Planting	... 563·94	13	Plucking and removing Coconuts	... 189·22
5	Roads and Bridges	... 824·67	14	Terracing	... 39·06
6	General Transport	... 17·71	15	Cinnamon	... 216·04
7	Tools and Machinery	547·75	16	Superintendent	...1,499·06
8	Miscellaneous	... 4,435·80			
9	Lines, Store and Bungalow	... 8,376·75		Total	...R34,023·94

COCONUT PLANTING IN CEYLON IN 1897:

DETAILED ESTIMATE FOR 200-ACRE ESTATE FOR 10 YEARS WITH EXPLANATORY NOTES.

(*By a Practical Planter.*)

We have pleasure in presenting our readers with the following carefully prepared estimate—see over—from the hands of one of the most reliable coconut planters in Ceylon. It supplies full details of expenditure year by year, for ten years from the first clearing of the land; allows interest on such annual expenditure at 8 per cent; and shews that the aggregate outlay is R74,053 plus interest R44,478 or a total of R118,531 which gives nearly R600 per acre or deducting the receipts in nuts for three years nearly R470 per acre. We think this is a very *safe* estimate. The crops are moderately estimated and moderately priced at R27 per 1,000; while we cannot help thinking that the allowance for expenditure is ample, though good land might cost more. At the same time, as the "notes" show, it is recommended that there should be 100 acres of pasture land as reserves and this would mean a cost of R1,000 more at least. As to eventual receipts, it will be observed that the anticipation is of three-quarter and even one million of nuts per annum—a maximum average of 5,000 per acre, or 67 per tree. This would require liberal cultivation to keep up. A million nuts would give R27,000 per annum of gross receipts—less, say, R10,000 outlay—or a profit of R17,000 or R58 per acre per annum. The detailed figures are on the following pages.

Estimate of Cost of Planting and Cultivating 200 Acres of Coconut up to the 10th Year, Showing also Probable Receipts for same Period.

ANALYSIS OF ESTIMATED EXPENDITURE.

Description of Works.	Cost.	8% Interest	Total.
1st Year.	Rs.	Rs.	Rs.
Value of Land, 200 acres at R20	4,000		
19,500 selected Seed Nuts at R75 per 1,000 ...	1,463		
Preparing and Tending Nurseries ...	120		
Felling, Clearing and Fencing	3,000		
Drains, Roads and Bridges	200		
Lining 24 × 24, and Holing 3' × 3'	1,250		
Filling in 18" and Planting	350		
Weeding, 8 months	1,600		
Watching	160		
Buildings	1,000		
Tools and Implements	200		
Superintendence	2,000		
Contingencies	200		
Total ...	15,543	1,243	16,786
2nd Year.			
Fence	120		
Drains, Roads and Bridges	200		
Supplies and Supplying	80		
Beetles and other Enemies	100		
Weeding	2,400		
Watching	240		
Buildings	100		
Superintendence	2,000		
Contingencies	200		
Total ...	5,440	1,779	7,219
3rd Year.			
Same as above with additional R50 for Tools			
Total ...	5,490	2,359	7,849
4th Year.			
Fence	80		
Drains, Roads and Bridges	200		
Beetles and other Enemies	100		
Digging and Forking round plants ...	200		
Weeding	1,800		
Watching	240		
Buildings	100		
Superintendence	2,000		
Contingencies	200		
Total ...	4,920	2,942	7,862
Carried over	31,393	8,323	39,716

Estimate of Cost of Planting, &c.—*Continued.*

ANALYSIS OF ESTIMATED EXPENDITURE.

Description of Works.	Cost.	8 % Interest	Total.
	Rs.	Rs.	Rs.
Brought forward	31,393	8,323	39,716
5th Year.			
Fence	75		
Drains, Roads and Bridges	200		
Beetles and other Enemies	150		
Digging and Forking round plants ...	225		
Weeding	1,800		
Watching	240		
Buildings	100		
Tools and Implements	100		
Superintendence	2,500		
Contingencies	200		
Total ...	5,590	3,625	9,215
6th Year.			
Fence	75		
Drains, Roads and Bridges, ...	100		
Beetles	150		
Digging and Forking round plants ..	250		
Weeding	1,500		
Watching	240		
Buildings	3,100		
Superintendence	2,500		
Contingencies	200		
Total ...	8,115	4,563	12,678
7th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles and other Enemies	100		
Ploughing half the estate, 100 acres ...	150		
Purchase and Keep of Stock	1,150		
Weeding and Clearing Tope	1,200		
Watching	240		
Buildings	100		
Tools and Implements	125		
Superintendence	2,500		
Contingencies	200		
Total ...	5,940	5,404	11,344
8th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles and other Enemies	50		
Ploughing other half of estate, 100 acres ...	150		
Keep of Stock	550		
Weeding and Clearing Tope	1,200		
Watching	360		
Carried over	51,038	21,915	72,953

Estimate of Cost of Planting, &c.—*Continued.*

ANALYSIS OF ESTIMATED EXPENDITURE.

Description of Works.		Cost.	8 % Interest	Total.
		Rs.	Rs.	Rs.
Brought forward		51,038	21,915	72,953
8th Year.—(Contd.)				
Buildings		290		
Picking and Gathering Crop		200		
Tools and Implements		200		
Superintendence		2,500		
Contingencies		200		
Total ...		5,785	6,299	12,084
9th Year.				
Fence		75		
Drains, Roads, and Bridges		100		
Beetles and other Enemies		50		
Ploughing 100 acres @ R1		100		
Keep of Stock		550		
Picking and Gathering Crop		250		
Weeding and Clearing Tope		1,200		
Watching		360		
Buildings		200		
Tools and Implements		75		
Cost and Transport of Manure		2,500		
Application of Manure		300		
Superintendence		2,500		
Contingencies		250		
Total ...		8,510	7,484	15,994
10th Year.				
Fence		85		
Drains, Roads and Bridges		100		
Beetles and other Enemies		50		
Ploughing 100 acres @ R1		100		
Keep of Stock		550		
Picking and Gathering Crop		450		
Weeding and Clearing Tope		1,200		
Watching		360		
Buildings		200		
Tools and Implements		75		
Cost and Transport of Manure		2,500		
Application of Manure		300		
Superintendence		2,500		
Contingencies		250		
Total ...		8,720	8,780	17,500
		74,053	44,478	118,531
Less Receipts :—				
8th Year 130,000 nuts @ R27 ...	R3,510			
9th „ 250,000 „ „ R27 ..	R6,750			
10th „ 420,000 „ „ R27 ...	R11,340	21,600	2,942	24,542
Net Cost of Estate		...	...	93,989

NOTES ON ESTIMATE.

It is assumed that the soil is good, the climate favourable, and the land so situated as to admit of its being opened and worked at a moderate cost.

1st Year.

Extent and Value of Land.—To cultivate highly an estate of 200 acres, after it has come into bearing, it would be as well to have an additional 100 acres of pasture land, so that a sufficient number of cattle might be kept for manuring purposes, as the estate itself would not maintain the stock required to manure half the total extent every year.

R20 per acre is, of course, but a nominal price, as superior forest and in favourite districts often sells for as much as R100 per acre.

Seed Nuts, Nurseries, and Supplies.—The selection of seed nuts is a matter of primary importance, but it does not generally receive the attention which it deserves. Attempts at economy in regard to the purchase of these are a great mistake and only result in loss. Nuts for nurseries should be thoroughly ripe and be known to come from healthy, middle-aged, heavy bearing trees. An allowance of 30% more seed nuts than the number of plants to the acre is necessary, namely, 10% for failures in the nurseries and 20% for supplies in the first 3 years. After planting the clearing, the surplus seedlings should be removed from the nurseries and put down 3 feet apart in a suitable site and receive careful attention. When supplying, remove every alternate plant on each occasion, so that those which remain may have more space as they grow up. By adopting this plan with supplies, uniformity is likely to be secured as there would be no disparity in the original plantation and supplies in respect of age and size.

Fence.—The timber on the land should provide materials for a fence which should not cost much to run up, and, with occasional repairs, ought to last about 2 years; but a good strong live fence is a desideratum and should be got up as early as possible. *Erandu* (Sinh.) interspersed with *Erabadu* (Sinh.) and *Imbul* (Sinh. for cotton) all grown either from cuttings or seed, the former preferable, would

make a neat and efficient fence; and the last-named would also give a small profit by its yield of kapok. There are a variety of plants which might be used for fences, but those named are easily procured and will usually be found the most suitable.

ROADS.—Provision is made for gradually gravelling the principal roads.

DISTANCE BETWEEN THE TREES.—24′ × 24′ is the proper distance in soil of average quality, but it should be modified to suit the various classes of soils, the extremes being 22′ × 22′ in inferior soil and 26′ × 26′ in superior soil. Some planters prefer 28′ × 28′ in the latter description of soil, but this is certainly a waste of valuable land, for the superfluous space afforded the trees cannot result in increase of individual yield, and, therefore, the crop per acre, with the fewer number of trees, must be considerably less.

WEEDING.—should begin early and be done chiefly by hand. All weeds should be either pulled up or cut out and left to wither on the ground before they begin to form their seed, while any jungle roots that have retained their vitality after the burning should be vigorously attacked with the "coontanie." It would be as well to encourage the growth of the gramineous and leguminous herbage as it is not necessary or advisable that the surface should be kept quite bare, except a space immediately round the plants which should be gradually extended till a circle about 6 feet in diameter is reached in the third year.

BUILDINGS.—A sum of R1,000 is put down for temporary bungalow with wattle and daub walls and a thatched roof: also a set of coolie lines.

4TH YEAR.

DIGGING ROUND PLANTS.—By the 4th year the holes will have filled up to a level with the surface, and the soil within the bare space round the plants might now be loosened to a depth of about 9 inches, and for this purpose a 12-inch three-pronged digging fork will generally be found the most serviceable.

5TH YEAR.

SUPERINTENDENCE.—An increase of R500 is allowed.

WEEDING—should cost a great deal less in the fifth year and still less in subsequent years, but from the 7th year on-

wards there will be an increasing quantity of "droppings" from the trees, and provision is made for their disposal preparatory to burning or burying.

6TH YEAR.

BUILDINGS.—The building of a permanent bungalow might now be considered, and accordingly the moderate sum of R3,000 is allowed for the erection; but the cost will, of course, be in proportion to the size and style of the building. R100 are also put down for coolie lines.

7TH YEAR.

PLOUGHING the whole surface might now advantageously supersede digging round the plants, one-half the estate being so treated every year, for it would be quite sufficient if the soil were ploughed in alternate years.

STOCK.—Four pairs of draught bullocks and their keep for the year are estimated to cost R1,150, and three ploughs R125.

9TH YEAR.

COST AND APPLICATION OF MANURE.—If it be desired to get the trees into full bearing earlier than they would if left to nature and to increase their fecundity, recourse should be had to manure. It is assumed that the available pasturage is sufficent to maintain 25 head of cattle, which number is required for manuring one-half of the estate each year. In manuring proceed as follows:—Tether two head of cattle to each tree for five nights. At the end of that period spread out the droppings over a circle 12 feet in diameter—the tree being the centre—sprinkle 3 lb. bone dust over the droppings and dig into a depth of 9 inches, incorporating the manures with the soil. If cattle manure is not available, apply a mixture of 3 lb. bones and 6 lb. castor cake in the manner above indicated, and immediately afterwards scatter 6 lb. wood ashes over the manured surface and gently rake in.

It will be observed that no provision is made for the purchase and keep of stock other than draught bullocks, but if it is intended to keep cattle for manuring purposes, a number of cows and heifers and a stud bull might be purchased in the 5th year, and in time the herd will increase so as to meet all requirements of the estate supplemented by such cattle as the villagers will readily offer for grazing on the estate.

If opened on the "Goiya" system the cost of felling, clearing, and fencing in the first year (R3,000) will be saved, and in favourable cases the owner's share of the subsidiary crops will realise R20 to R25 per acre for the two years.

Receipts.

8th year.—No crop is estimated for before this year, for although under favourable conditions there would certainly be some crop in the 6th and 7th years, it has been left out of the calculation as its amount is uncertain. 130,000 nuts may be expected in the 8th year worth at R27 per thousand, R3,510.

9th year.—250,000 nuts value R6,750.

10th year.—420,000 nuts value R11,340.

The crop will increase year by year to about 750,000 nuts in the 15th year. With liberal cultivation and manuring it may be further increased to a million nuts, and the yield maintained at the figure up to the 70th year probably.

G. T. N.

DESICCATING COCONUT.

This is done with best selected well-matured nuts—the unripe, over-ripe and unsound being carefully rejected and converted into copperah, which being inferior generally fetches a low figure per candy. The desiccating starts by men opening or shelling the nuts, which is done with little hatchets somewhat lighter than an ordinary shingling hatchet; at some mills little circular saws are used, but I prefer the hatchet. The men become very expert at this, but at first their wrists swell up and they cannot earn a good day's wage. They get paid, as a rule, 50 cents per 1,000 nuts, and many of the best choppers make over R1 per diem. They are then passed on to the paring or shaving women who take off all the red rind, leaving the pure white kernel. They are then passed on to the washing tanks where boys with little pieces of tin, made like nutmeg-graters, rub off any red specks the women may have missed. The implement used by the women is a common carpenter's spoke-shave which has to be constantly sharpened, and the nuts must be broken so as to let the milk run out, If left in, it is said to turn the stuff yellow. For this work the women get 50 cents per 1,000 nuts and the best can shave 1,200 in a day of 12 hours, often finishing their work by 4 p.m.

The nuts, after being thoroughly washed, are then passed on to the Disintegrating Machine and ground to a mass just like your cook does it for curry. In this condition it is taken away in trollies to the Desiccators (Brown's) and dried at a temperature of 160°. It comes out quite hot; and after cooling down to luke-warm it is graded by sifters or by hand sieves into the three-grades—Fine, Medium, Coarse—and while still warm it is packed at once into ordinary tea chests, lead and paper lined, as a rule 130 lb. net per chest. The chests are then marked, hooped and despatched.

All nuts, if for copperah, desiccating, or shipping, must be heaped and withered (matured) in the husk for three weeks before they are fit for the market. The usual rate for husking is also 50 cents per 1,000, and this, like plucking, is done by men who come round regularly for the job. The buyer pays the cost of husking.

The parings are kiln and sun dried and sell for R33·50 to R45·00 per candy to chekku men, being rich in oil. Other grades are made, such as chips and strips by special machines for the purpose, only two of which we have here. C. M. B. W.

SOAP AND COCONUTS!

From "Ceylon Observer," Oct. 24th, 1907.

It is believed that soap came to the Romans from Germany and that the detergents used in earlier times and mentioned as soap in the Bible refer to the ashes of plants, still so often employed by our "dhobies" and others in Asia. In England the soap trade did not exist till the 16th century, and from 1712 to 1853, an excise duty of from 1d. to 3d. a lb. greatly impeded the development of the industry. In the last year (1852) in which the duty was levied, it realized as much as £1,126,046 : but with the abolition of this tax on cleanliness, a great advance has since been made, although there is no means through Customs or Excise of testing its extent. Marseilles has long been recognised as a most important centre of the soap trade, and this arose from its ready command of supplies of olive oil from Italy, Spain and the Riviera. Of late years, however, dependence has been placed to a far greater extent on palm (including coconut) oils, castor oil, ground nuts, sesame, &c., and of course there is a great trade in these products to the French commercial capital on the Mediterranean. Let us now quote from an authority as to the raw materials chiefly used by the soap-boiler :—

> Among the raw materials used by the soap-boiler the principal fatty bodies are tallow, lard, palm oil, palm-kernel oil, olive oil, cotton-seed oil, sesame oil, and coconut oil for hard soaps, and fish oils, linseed oil, marrow fat, and the lower qualities of other oils obtained by extraction, &c., for potash or soft soaps. Almond oil, spermaceti, coco-butter, ground-nut oil, and some others form the basis of certain toilet and medicinal soaps. Resin and colophony form essential ingredients in yellow soaps. The alkalis are used almost exclusively in the condition of caustic lyes,—solutions of their respective hydrates in water. Caustic soda is now obtained direct from the soda manufacturer, and one operation, causticizing the soda, is thus spared the soap-boiler. Potash lyes are, however, principally sharpened or causticized by the soap-boiler himself from potash carbonate.

Now, it is quite certain that the increased value of coconut oil and copra of recent years finds much of its explanation in the increasing manufacture of and, demand for soap. The people of Ceylon have, therefore, a direct and considerable interest in the prosperity of the soap-trade ; and, believing as we do with old John Wesley that "cleanliness is next to godliness," we can hail with the utmost satisfaction the expansion of an industry which benefits this Colony materially, and an increasing proportion of the population of the world morally as well as physically. "Prosperity to the Soap-trade" should be a favourite toast with all Coconut-planters! And here, as

in the case of Rubber, there seems no limit, at least for a generation or more to come, to the fresh demands that may be made for Soap. When we think how little, comparatively, at present, the vast populations of Asia, Africa and even of South America must use of soap, as compared with Europe and North America, we can see there is "ample room and verge enough" for a vast extension of consumption. To show how, even in West Africa, cleanliness is becoming the order of the day, we have only to go to the Lagos Railway Report for last year which includes an illustration, as well as a valuable sociologicial sentence, when we are told that "under soap there has been a noteworthy increase of 69 tons which may perhaps indicate a growing feeling after a higher level of existence." No doubt of it; and here in Ceylon our statistics show how much progress can be made in an advancing native community. In 1850, the total value of soap imported was R4,270; in 1865 it was R12,470, and soap was no doubt dearer then which would mean a practically smaller quantity. In 1906 our imports equalled 4,198 cwt. of toilet and 14,579 cwt. of bar soap, the whole being valued at R164,183 or an increase of over thirteen-fold in thirty years; and we have no doubt that the increase will be even greater during the coming generation. A similar process, we may feel sure, is going on all over the world where peoples are emerging from ignorance, sloth and poverty to enlightenment, industry and comparative comfort. The demand for soap is bound to increase year by year. At one time there was an appreciable local manufacture of common soap; but we believe this has been abandoned in favour of the imported article. It may be said that with the Messrs. Lever and others covering whole islands in the South Seas with coconut palms, there is a danger of overproduction here (as in the case of 600,000 acres and more of planted Rubber in Asia) and that the products may gradually but surely fall in value. It is impossible to make quite sure; but we think it will be found that the Coconut-planting as well as the Soap-making and the Rubber-planting industries have all a solid basis of prosperity, due to a widely expanding demand for many years to come, for both soap and rubber.

APPENDIX.

"COCO-NUT OR COCOA-NUT."

We call special attention to the following editorial note from the *Pharmaceutical Journal* of London early in 1888. We have for several years back with the concurrence and approval of the highest authority in the island (the Director of the Royal Botanic Gardens*) adopted "coconut" in all our publications. The difficulty usually is to get people at home to aid in a change of the kind, but now that the step has been taken by so good an authority in England, we trust all writers, printers and publishers out here will follow suit and do what they can to make the convenient and indubitable form of "coconut" universal. We would especially appeal to our contemporaries, to the Department of Public Instruction (and Agriculture?), and last but not least, to the Government Printer† to adopt what is so clearly and scientifically shown to be the correct form. If we could only convince "Mincing Lane" we should like next to see "cacao" adopted for the produce as well as the tree; but this is more difficult, "cocoa" as pronounced being a universal household as well as "market" word for this food product and drink, in England. Still if "coco" is kept for the nut, there will be much less risk of "cocoa" beans, nibs, or paste being supposed to come from the palmtree. Here is the paragraph:—

"COCO-NUT OR COCOA-NUT.—A discussion as to whether this should be spelled c-o-c-o or c-o-c-o-a has recently been published. The palm yielding the coconut and the tree which furnishes the substance used as a beverage and called cocoa, are known by botanists, and hence by pharmacists, to have no connection. Nevertheless, many persons outside that intelligent circle have an idea that both are products of the same tree, or are connected in some way, and even botanists do not agree as to the correct spelling of the word coco in coconut. The evidence on the subject is briefly this:— In early botanical works and books of travel coco-nuts are mentioned, the word "coco" being derived from an Indian word coc or cocus, used to indicate the fruit of *Cocos nucifera*, or coconut of a fancied resemblance of the base of the endocarp, with the three circular impressions, to the face of a monkey whose conversational powers were limited to uttering a sound like coco or cocus. According to another authority the word "coco" in Portuguese means anything which frighten, the monkey-like expression on the endocarp being perhaps used for that purpose. Linnæus in forming the genus *Cocos* probably founded the name on these variations, and how it came to be known as cocoa (c-o-c-o-a) nut is not quite clear, but there is nothing to warrant such a method of spelling. Now that the leaves of *Erythroxlon Coca* are also articles of commerce and known as coco (c-o-c-a), it becomes a matter of much importance to discriminate carefully between the three substances of similar names but widely different nature."

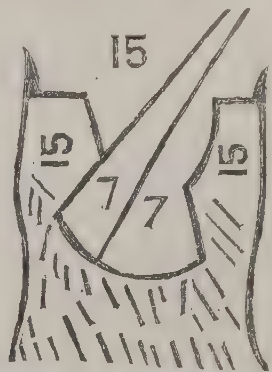
* This was the late Dr. Trimen, F.R.S.; but his successor and staff hold the same view, we believe.

† We are glad to say that now (1907) in all Government publications in Ceylon, the spelling "Coconut" has been adopted. The rest of the Ceylon, Indian and London press should all follow suit.

THE "CHEKKU."

OR SINHALESE MILL FOR MANUFACTURING COCONUT OIL.

The native oil-mill or chekku may be of wood, stone, or iron; it is a large mortar, firmly fixed in the ground, and a corresponding pestle, wrought by a lever, with which a pair of bullocks travel round in a circle. The accompanying sketch shows the forms of the mortar and pestle.



The chekku stands about three and a half feet high. The lever is made to fit into a cup, on one end of a piece of hard strong wood, about three feet long: the lower end of which has a hole through which a rope is passed, to suspend the lever. The lever is a straight tree taken up by the root, sixteen feet long, and large enough to square one foot at the lower end, and not less than six inches at the upper. The root is cut to fit a grove round the chekku, and at four feet from the groove a piece of strong wood, six inches by three, is passed through a mortice, and firmly secured, and a hole at the upper end corresponds with that on the lower end of the cup piece, and the lever can be raised or depressed by lengthening or shortening the connecting rope. The action of the pestle, when the machine is at work, is a double one, of grinding and pressing; in front of the pestle, the copra* is thrust down the opening, between the pestle and the mouth of the chamber, and is pressed upwards again, after the pestle has passed over it, and the business of the attendant is to return all that is thrown out on the table, and to break up and turn the cake from time to time.

For the chekku work, the copra must be as dry as the sun can make it, and if put in hot, so much the better. A "turn" of copra is 42 lb. and should the chekku be in perfect order, and the copra perfectly dry, the result will be 28 lb. oil, and 14 lb. poonac; six turns is a day's work: 252 lb. copra equal 168 lb. oil and 84 lb. poonac.

There are only three kinds of wood used for chekkus:—kón†, tamarind‡, satin §, and the same for pestles, to which may be added very old and very hard coconut wood. The pestles are the most costly part of the upkeep of a chekku, as many of them split the first turn. Stone chekkus are from R40 to R70 at the quarries, and an iron pestle, though costly at first, is cheapest in the end. Iron chekkus cost some R250 in England f. o. b., and they are apt to be spoiled, by the conceit of the home engineers, who usually fancy that they can improve on the drawings or models sent them. I have had several improved into impracticability by this means.

COCONUT CULTIVATION IN CEYLON.

We direct attention to the valuable notes for young coconut planters given below, compiled and placed at our disposal by "W. H. W." —initials which will be readily recognised as those of one of the most successful planters in the island. How he has made his Mirigama property so great a success will be at once understood after perusing his instructions to all who wish to follow his steps and have a thoroughly satisfactory coconut clearing and plantation of their own. How very differently many planters have acted is only too evident in what we see in many directions

* Copra is the dried kernel of the coconut.
† Schleichera trijuga.
‡ Tamarindus officinalis.
§ Chloroxylon swietenia.

even in regular plantations; while native gardens are in the majority of cases planted after the most haphazard fashion. One exception to the rule in the case of small gardens was that for which we quote statistics below, to which our esteemed correspondent "Polgaha" makes reference after "W. H. W.'s" Hints.

HINTS TO THOSE ABOUT TO OPEN LAND UNDER COCONUTS.

Suitable land for coconuts having been purchased, it would, in my opinion, be very unwise to commit the common error of clearing it at once. One's first care should be the selection of nuts from well-grown, healthy trees whose branches do not droop or show a tendency to fall off prematurely; the nuts should be large and heavy with a full kernel. So strongly am I of opinion that a careful choice of nuts is most essential, that I would recommend paying R10 or R15 more per 1,000 than the rates ruling, in the districts where you buy, for the privilege of being allowed a free hand in their selection. On deciding what nuts will suit you, send your men once a month to pick one bunch from each of the selected trees; and when picking, each bunch must be lowered to the ground by means of a rope, or the nuts picked separately and dropped down one by one carefully.

When you have the requisite number of nuts for the acreage you intend opening, prepare your nurseries; the soil should be turned over well and burnt before levelling. Set the nuts close to each other, and in a slanting position; shade them from the sun, and water during dry weather. The nuts will germinate within four months from date of putting down, and if at the end of five months there are any which show no signs of growth, reject them, for they will never make healthy trees. When the seedlings are from 2 to $2\frac{1}{2}$ inches high, transplant them at intervals of 18 to 20 inches in another nursery, where they would have more sun; ashes applied lightly after transplanting will help the growth of the plants greatly. The plants when twelve months old will be big enough to put out into your clearing, and sufficiently strong to withstand the attacks of white ants, one of the most formidable of enemies of the young coconut plant. On removing the plants from the nursery, carrying them by their branches must be strictly forbidden, as want of care in this respect is very likely to result in injury to the "cabbage." May being a wet month is the best time of the year for planting.

In getting your land ready do not stint money on holing, the holes should be cut 3 feet square and 3 ft. deep and lined 26″ × 26″; burn as much wood and rubbish as you can get in the holes, and fill in with surface soil till they are 18″ deep when you should put down your plants, after trimming the roots carefully, and press the earth down firmly round the nut. In undulating land terracing is very desirable, while all ant-hills should be levelled to the ground and the earth from them applied to the adjacent coconut trees. There are 66 plants to the acre, but in your nursery it will be as well to allow an average of 80, so as to provide for supplying vacancies caused by drought, white ants, beetles, lightning, &c.

After planting, give out your land on contract to native cultivators (goiyas) for three years for the purpose of raising potatoes, cassava, &c.; in return for your granting them this privilege they must keep the coconut holes free from weeds and grass and if they fail to do this they must submit to the forfeiture of one-half of the crops they raise. The goiya must also undertake to report the destruction of any plant, so that the vacancy may be filled immediately after the first rains. No vacancies should be allowed to remain unsupplied, as a property is greatly lowered in value by the presence of gaps.

As I have said the ills a coconut property is heir to are:—drought, white ants, beetles and lightning.

Of *beetles* the worst is the red kind (Sinh: *Kandapanuwá*). Any tree attacked by this fearful pest must at once be rooted out, chopped into pieces and burnt without allowing any of the insects to escape; the remedy here is very drastic, but there is no other, and if the one I advise is not adopted the result will be the scattering broadcast of a perfect army of destroyers to ravage not only your own, but your neighbours' estates. I have myself made it a point to find out and burn trees attacked by *Kandapanuwá* anywhere within two miles of my property; when a case is brought to my notice I send my own coolies to the spot to cut down and burn the tree, and as compensation for saving my neighbour further loss I make him a present of 50 cents!

When a tree has been partially struck by *lightning*, steps should at once be taken to bleed it and the surrounding trees by boring holes at their bases with an auger, by which means a large percentage can be saved. Any tree, however, that has been irretrievably struck by lightning should at once be cut down and burnt to prevent the breeding of *kandapanuwà* within it.

Drought.—I do not water any plants when they are once put out in the field: they should be planted during the May rains. I only water them when they are in the nursery, and the plants are generally one year old where they are put out.

Again, I lose very few plants by *white ants*; there are sometimes places where they destroy them often, and in such places I put in 2 years-old plants. Be careful in such holes not to allow any grass or weeds to be put in when filling them up.

I may mention that there are about 30 different kinds of coconuts and I do not, as a rule, prefer to get nuts for the nursery from any one district. I have seen very good nuts got from Veyangoda, Negombo, Mirigama and Colombo. I get them from selected trees, not younger than 20 years-old, let the nuts be large and heavy, as I said before, with a full kernel.

In reply to the question as to the average yield of a coconut tree, I may mention that during my experience I have seen trees which have borne 100 to 150 nuts each per annum; the yield, of course, depends on the nature of the soil, the locality and the manner of cultivation. I have recently visited an estate of about 150 acres in the Chilaw district which I valued at R1,000 per acre, and I was told by the owner, who has refused an offer of R1,200 per acre, that he gets over 100 nuts per annum on an average from each tree.

Land cleared and planted by me in May 1887 is now in partial bearing, 200 trees have borne a crop, from which copra was made and sold.

W. H. W.

Kandangomuwa, Mirigama.

THE JUDICIOUS USE OF MANURE.

For the benefit of such coconut estate owners as are sceptical of the profitable results which follow the judicious use of manure, you are at liberty to publish the annexed statement showing the yield, during the last 4 years, of two of the best fields on a coconut plantation of about

200 acres in extent, in the Western Province, the soil of which naturally a poor light sand more suited to cinnamon than coconut, has been much ameliorated by cultivation and liberal manuring.

STATEMENT REFERRED TO.

Field A—extent 15 acres.

Trees in full bearing, about 45 years old	...	1,123
,, partial bearing, 12 to 15 years old	...	142
Total trees...	...	1,265

Field B—extent 10 acres.

Trees in full bearing, 45 years old ...	...	658
,, partial bearing 12 to 15 years old	...	66
Total trees...		724

Fields :

		A		B	
In 1889-90	...	52,322	nuts.	29,422	nuts.
,, 1890-91	...	65,055	,,	36,329	,,
,, 1891-92	...	60,650	,,	32,382	,,
,, 1892-93	...	65,324	,,	38,025	,,
Total	...	243,351	,,	136,158	,,
Average for 4 years.	...	60,837	,,	34,039	,,
Per tree per annum	...	48	,,	47	,,

The gross return from the larger of these fields in 1892-93 was R2,751·47 and the cost of production per 1,000 nuts R12·15, leaving a net profit of about R130 per acre.—Yours truly,

POLGAHA.

(Answer to Criticism on above.)

Our critic unjustifiably suspects that "a rough and misleading guess" was made with regard to the extent of one of the fields referred to, which it is arbitrarily suggested is "nearer 20 acres than 15"

In drawing this conclusion two things are assumed :—(1) that the trees in the field in question are planted farther apart than one would naturally infer from the figures given in the statement appended to the letter, and (2) that "Polgaha's" knowledge cf the act of reckoning is too limited to enable him to calculate with any approximation to accuracy the extent of land covered by a given number of trees placed at certain distances apart from each other.

The reason adduced for the first assumption is that more than "84 trees to the acre would not be good planting" (I would fix the limit for "good planting" at 75); but the purpose of my letter and statement was not to show the results of good planting but to prove the profitableness of liberal manuring.

There was no guess-work whatever in the statement in question, and in describing field A as of 15 acres, I did so advisedly; the trees, in this field as well as in the other referred to, are planted from 22 to 23 feet apart, and there are a number of young plants besides the bearing trees.

What manures to use and how to apply them have already been recommended by the best authority on the subject in the island, and if his advice be followed in the treatment of bearing trees and "W.H.W"'s instructions be attended to in the opening of plantations, even larger profits than R130 per acre may be calculated upon with the rates now ruling for nuts.—Yours truly,

POLGAHA.

PROFITABLE COCONUT CULTIVATION IN CEYLON.

(From an Old and Practical Coconut Planter.)

HAPITIGAM KORALE, 9TH JUNE, 1886.

I was lucky enough to finish all the planting I can do this season, while the rain lasted, and the goiyas have very nearly finished their sowings, so that our operations bid fair for success all round. The goiyas having felled and cleared the land, the owner's work begins, and the following is the cost of my operations:—

Lining per acre	R0·25
Holing ,, ...	2·25
Plants ,, ...	3·00
Planting and Carriage	0·37
	R5·87

Being only five miles from a railway station, I have, on this occasion, cleared R8·50 per acre for firewood for the engines, so that the operations of the season leaves me R2·63 per acre profit.

The goiyas keep the land in hand for three years; they first sow kurakkan and mun-eta, and then mamotie-weed the land by way of harrowing, then sprigs of sweet-potato vine are put ten or twelve feet apart, and bits of cassava stem five or six feet apart. The grain and pulse first take up the growing, and keep everything else down, while they occupy the ground; when they are harvested, in the fourth month after sowing, the cassava gets its innings, and keeps the ground for about a year. The sweet-potatoes come in at the end and continue to be gathered for twelve months at most. Of all those crops, the land share is one-third, and the value may amount to anything between five and thirty rupees, according to the soil and seasons, but, taking the mid-term of R15, we have nearly R20 per acre, to the good, at the end of the third year. As soon as the crops are finished, any germs of jungle, that survive in the land, rush up at once, lantana shoots up in all directions, and the seeds of kinds of weeds, common in the vicinity, find their way to the land. All these are easily and cheaply dealt with at first, but if allowed to spread they soon close in and overtop the plants, and those that are not fairly smothered out, have to maintain a severe struggle for existence, being in no case the fittest to survive. At a cost not averaging more than R5 per acre per annum, a fine field of natural pasture grass may be established, and kept up till the trees come into bearing. Of 200 plants I put down in May 1879, ten per cent are now in flower, and I have already gathered nuts from the most forward tree.

MR. DE SOYSA'S MOUNT LAVINIA GARDEN PLANTED ORIGINALLY BY REV. DR. MACVICAR.

One of the best little gardens we know in the island is that from which we are enabled on the best authority to give the return of crops gathered as follows:—

[G.—B., 14 acres in extent, with 1,151 bearing coconut trees standing thereon, or about 82 trees per acre:—]

Produce in	nuts.	Produce in	nuts.
1883 ...	57,000	1889 ...	60,300
1884 ...	56,200	1890 ...	60,500
1885 ...	57,600	1891 ...	61,000
1886 ...	58,300	1892 ...	60,700
1887 ...	59,000		
1888 ...	59,600	Total...	590,200

Average for ten years 59,020 nuts; per acre 4,215 nuts; per tree per annum about 51⅓ nuts. We do not think there are many places in the country that can show a better return than the above for ten years continuously

The garden in question is situated opposite the Mount Lavinia Hotel, and was originally planted with very great care some time in the "forties" under the supervision of the Rev. J. G. Macvicar, the learned and accomplished Scottish chaplain of that day. Mr. Macvicar bought Mount Lavinia from Government (as a great bargain) and going to reside in it, he, in his leisure time, gave attention to planting the 14 acres of waste land opposite with coconuts. Very vividly did the chaplain's daughter, Mrs. Green—who has just gone to England—recall the scene to us when, as a very little girl, she watched her father's careful selection of the nuts (after the fashion prescribed by "W. H. W.") for his servants to put in the nursery. The garden is on fairly good soil, much of it cabook, and it has been favoured with washings from the high road and higher land for many years. The trees which have yielded the average of 51⅓ nuts each per annum for the past ten years must now be about 45 years old. "Polgaha"'s own experience (page iv) is of special interest; he gives returns for two best fields on a valuable plantation, and the result is an average yield of 47 to 48 nuts, while the profit in a good year like 1892-93 reached so satisfactory a figure as R130 an acre. What more could be wished? Tea, no doubt, in special cases does better; but considering the comparative permanency of the two industries, such coconut land, we suppose ought to be worth double the value of tea land yielding the same profit per acre?

THE COCONUT TREE AND ITS USES.

To the Editor of the "Ceylon Observer."

SIR,—The coconut tree belongs to the tribe of palms. It is said, and truly so, that of a coconut tree a ship can be built and laden too. It grows to the height of 60 or 70 feet from the root, and the trunk gradually tapers, and almost at its summit it spreads out into what are called branches, and each leaf is divided in the centre by a thin woody rib which is called the mid-rib. The leaves are useful both in their fresh and dried states. The dried leaves are, after soaking for a short time in water, separated from the branch and dried and plaited, they form a plaiting of leaves woven into each other, and are called cadjans; these cadjans are used for covering houses, fences, and roofs of country vessels. The leaf and branch or leaf stalk undivided and plaited with one another make good substitute for tats, and are cool and refreshing when fresh. The trunk of the tree at its lowest part is six or eight feet in circumference; when divided into two, it is used at gutters and in some places as rafters, but is not equal in duration to the palmyra rafters. From the bottom upwards there are concentric rings which mark the place where the old leaves were attached. The flowers are generally enclosed in thick horny-looking but fleshy cases which are called spathes; they are in clusters on each side of a stalk. From the spathe and flower a liquid substance is obtained resembling watery milk which is called toddy. This is sweet and refreshing when fresh, but when exposed or kept too long becomes sour and intoxicating. Spirits called arrack is obtained from the toddy in such large quantities as to afford a revenue to Government and an article of trade. Of the sour toddy vinegar is made; from the sweet toddy collected in large quantities boiled and evaporated a sweet substance is obtained which is called jaggery. The fruits grow in clusters; some varieties of them are comparatively large; when tender or fresh plucked, the nut has a green fibrous coating under which are fine fibres of a reddish yellow color which cover the shell. The shell is hard and woody; it encloses the white fleshy kernel and some water. The outer covering of the coconut, although generally cast away, when dried, may be used for fuel; the underlying fibres when washed and cleaned and separated are called coir fibres. These fibres are used for a variety of purposes; they are made into coir rope of different thickness and strength; they are made into mats, rugs and brushes, and have been plaited and made into hats and bonnets; they are

also used for cushions, mattresses and many other things. The shell can be divided into two and used for ladles, cups and drinking vessels: sometimes only the top piece is sawn off and graven with varieties of designs. The kernel is a white and comparatively soft substance which is found inside the shell; in its early stage it is like jelly and can be easily scooped out and eaten; it is cooling and refreshing. In an advanced stage it is harder and may be scraped; in this stage it is used in making cakes; when boiled with sugar it is called "chincha" or "chinchareen" in Portuguese. This is put into pancakes and rolled and is called "throothas." When still more hardened and matured it is scraped out, and milk is expressed out of it which is sweet and of a thicker consistency than cow-milk. The milk is used for composition curries and forms a nice gravy when boiled together with curry stuffs, etc. It is largely used for this purpose by the people of India and Ceylon. When boiled and evaporated, a fine clear oil is obtained which is used as a hair oil and is the best for improving or promoting the growth of hair; it makes hair soft and glossy. The refuse of the scraped coconut makes very good food for poultry. The coconut when allowed to dry to some extent is an article of trade and exportation and is called copperah, and the oilmongers extract large quantities of oil, which is used for lighting purposes. It is extracted by a rude kind of mill called chekku, made of wood and worked by bulls. The refuse after being extracted comes out in large cakes and is called poonac, which is used as food for animals and may also be used as manure for trees.

By way of recapitulation it may be stated that a vessel may be built by layers of rafters both for the ribs and sides of the hull of the vessel. The interstices or seams may be filled by coir fibres, then caulked and painted. The floor of the deck may be laid with rafters and these also caulked and painted. The mast may be made of the well-seasoned trunk of the coconut tree. The rope and hawsers may be made of the fibres; the sails may also be made of the same. Then the vessel will be from stem to stem made entirely of the coconut tree. It may be laden with the following:—Coconut rafters, coir yarn, mats, rugs, brushes, and coconuts. It may also beladen with arrack, jaggery, copperah, coconut oil, poonac and cadjans. So the vessel will be actually built and laden with the coconut tree itself. There are several kinds of coconut: the ordinary "nawasi," of which the fleshy covering of the kernel is tender and may be eaten, is of a sweet taste; the king coconut, the outer skin of which is white, is of two kinds, the large and small size; then there is what the Tamils call "suriya kavelle" (sun-faced)—if the stalk-end of the surface of the coconut is cut, it presents a beautiful red appearance; this is supposed to be caused by the face of the sun, but how it is so is not known—the natives use this kind particularly for medicine. Then there is the small hard kind which the natives called "pora tengai," the shell of which is very hard, and they use it for breaking against each other on their New Year's festival, which is about the 12th of April. Then there is the dwarf coconut tree which looks very ornamental, and the Maldive is also another kind of coconut.

SILEX.

THE PINK COCONUT.—We have before us a young coconut whose outer husk presents no unusual appearance, but a cut discloses a bright pink inner husk. The nut is from a tree growing on Crow Island near the mouth of the Kelani river, which is said to have been planted by the late Mr. H. M. Fernando, one of whose sons tells us that the Sinhalese believe that the husk has some medicinal properties. The plant is said to have been got from Jaffna. Can any of our readers give us any information regarding this rare and beautiful coconut?—"Examiner." [A pink color at the ends of young coconuts we have observed. The late Dr. Gygax extracted a pink dye from the coconut husk, to celebrate which event, Mr. Taylor of Batticaloa wrote a poem in the *Observer*, "Couleur de Rose."—*Compiler.*]

THE PINK COCONUT.—The pink coconut referred to above is called *ran-tæmbili* by the Sinhalese, probably owing to the pink colour of the inner part of the husk at the upper end of the nut. The colour does not go lower down the nut than three or four inches. There were a few years ago (and likely there are still) a couple of trees bearing this description of nut, in the village of Paiyagala of Kalutara district, about three miles and a half south of that town, and near the high road to Galle. Externally the nut has the appearance of an ordinary drinking coconut, but of a slightly lighter green, and smoother surface. To a careless observer these distinctions would not be apparent. The Sinhalese, I have heard, believe the *liquid* in the nut, and not the *husk*, as the "Examiner" has it, is possessed of some medicinal properties, and use it in the preparation of some of their decoctions. I am of opinion that this *ran-tæmbili* is not a distinct variety of the coconut, but an accidental growth, or what may perhaps be technically known as the *sport* of nature. Now there is another description, with a green husk too, known as the *pæni-pol*, or honey, or sweet coconut, the flesh of which, adhering to the inner side of the shell, is as sweet as if it was preserved in sugar, whether the nut be tender or ripe. This too, I believe, is not a variety, but like the other, a mere caprice of nature; or to be probably accounted for, in the former case, by some red colouring matter in the soil where the trees stand, or some sweetening substance in the latter case: for, how is it then that these two descriptions could never be propagated from seeds taken from a well-defined tree? The Sinhalese have often assured me that the experimental plant produces nothing but the ordinary green coconut. Now the way to test the fact, that these two are not varieties, is, I believe, to mention the *ran-tæmbili*, our beautiful orange-coloured king-coconut and the *nawasi*; the former yielding a delicious, cool, refreshing and health-giving drink, and the latter not only affords a cool refreshing beverage, but the larger part of the *husk*, the upper part of which is as tender as carrot, is a pleasant food for the natives, and both of which are well established varieties. It would be interesting to know what W. F. has to say on this subject.—*Cor.*

COCONUT CULTIVATION IN CEYLON.

(*From the "Ceylon Examiner."*)

The July number of the *Tropical Agriculturist* opens with a very interesting and highly-instructive paper on Coconut Cultivation by a veteran planter, "W. B. L." The paper is perhaps not as full with details, modes of culture, &c., as another paper on the same subject which bears evident traces of the same pen, and written nearly a decade back. To those engaged in coconut cultivation, I would advise the careful perusal of both papers, as likely to afford many useful hints. I cannot more than give a slight sketch of the last essay. The best soil for coconut is said to be alluvial loams subject to periodical inundation. The next, brown loams, after which comes sandy loams. Solid cabook, and stiff clays are to be avoided. The nearer the land approaches the level, the better is it for coconut cultivation. Nurseries must be made eight months before the plants are wanted, with 50 per cent more nuts than the number of plants necessary. Those that do not germinate within 5 months are to be rejected as likely to be laggards all their life. The careful selection of seed-nuts is of the first importance. The trees from which the nuts are taken should be mature, healthy and in heavy bearing. The nuts must be thin-skinned and ripe without being dry. Considering the length of life of a coconut tree, it is really a pity that no attention whatever is paid to the selection of the seed-nuts. Any and every nut one comes across is put in the nursery, or plants are bought from anywhere. The beds, we are told, are to be 4

feet wide, and made by digging the ground 6 inches deep and placing the nuts with the stalk end upwards. After experience, I have a decided objection to placing the stalk end upwards, and for this reason, that there is a depression at the stalk, which is directly over the "eyes" of the nut or the seat of the germ. At the depression the husk is not, as elsewhere, to a certain extent impervious to moisture. All the moisture taken in at the depression works its way downwards, and by the action of the sun causes a certain amount of fermentation that destroys the germ. If the nuts are placed sideways, these objections are overcome, and the germ is kept constantly moist by the water within the nut—which is not the case in the other position—and offers greater inducement to speedy and successful growth. It strikes me that the information now given to fill up only the spaces between the nuts with soil, does not quite accord with what was written by the same writer a few months back when theorizing on the depth the seed of the different palms ought to be put in the ground to ensure successful growth. In that communication, which was one of a series of monthly reports of a new products estate, it was said that coconuts must be planted with six inches of soil above it. It happened that I had just about that time formed a coconut nursery in the usual style, that is with the top of the nuts peeping out. I was asked why I did not follow the new plan by one interested in the nursery, and as his wishes seemed to lie in the newly-suggested direction, I took no step to remove from the nuts all the earth that had been washed over them—for, remember, my nursery was below a slope. What was the result? About 90 per cent of the nuts rotted and refused to grow; so much for theories, and for leaving the well-beaten track of experience to follow the attractive paths of theory.*

To return to the essay. The lining must be in squares 25 ft. each way. The holes must be cut with the first rains in March, and must be 3 ft. cube and be half-filled with the top soil and ashes. If this were always followed, we should certainly have strong, healthy plantations, giving good crops without extraneous aid. Instead, we find the general practice is to cut, or which is thought to amount to the same thing, to give orders to cut holes 18 inches every way, into which the plants are put with no attempt to give them a start by putting a little of the rich surface soil and ashes round the nuts. And this is the universal practice among those who should know better. Fencing your clearing to keep out cattle is said to be the next step, and a live fence is recommended of either *erandu* or *kaju*. A paragraph is devoted to the discussion of secondary crops on coconut clearings, and much speculation is indulged in. The writer has no objection to any secondary crop which covers the cost of labour, pays for fertilisers in the place of what it removes, and leaves the owner something besides. I venture to believe he is not singular in this as this object is the sum total of the aspiration of every reasonable cultivator. The usual secondary crops of the goiya system do not, it is said, meet these conditions, and kurakkan, it is said—on what authority we are not told—consumes a vast quantity of phosphates and nitrates. I quite endorse the writer's suggeston that it would be better to grow chillies in the place of kurakkan, manioc and sweet potato: for chillies do not meet a local but a general want. Whether a chillie crop is more profitable I am not quite sure, for it must be borne in mind that chillie cultivation is garden cultivation, which, for its success, requires that the soil be constantly hoed and kept free from weeds. This means the expenditure of a vast amount

* Will not placing coconut on their sides in the nursery be a departure from the well beaten track of experience? Yet it would be wise to try it on a small scale. The failure of 90 per cent would be conclusive against the experiment, assuming that the nuts were well ripe, and that silt washed down a slope is as useful as fresh soil. Again, may not the position of the nursery have given it too much moisture? We wish coconut planters more often published their experiences for the common good—Ed. "Ex,"

of labour and energy constantly, of which the average Sinhalese is incapable or averse to unless stimulated by the prospect of a daily wage, when it will be found not to pay. Every one will be inclined to agree with the writer of the essay that if a proprietor has the capital (I am inclined to add to capital, will and energy, for we see capital by itself never used aright), he can put his land to more profitable use than to give it to goiyas. Croton and arnatto are suggested. The former yields a very powerful purgative oil used in very small doses and in exceptional cases. Increased supply will bring down the present high prices. As for arnatto, the cost of detaching the seed from the outer covering is very large and will swallow a large portion of the profit.

Amongst the enemies of the coconut tree, the wild pig has the first place. Not only because he is the most destructive to a young plantation I suppose, but because he is about the earliest enemy the plant has to contend against. The white ant comes next, and its ravages are simultaneous with those of the pig. Arsenic is said to be the best preventive, and the difficulty of applying it in minute doses is supposed to be overcome by filling a tub with water and adding a quarter pound sugar and two grains arsenic for every gallon of water and flour sufficient to make the mixture assume the consistency of whitewash. Each plant is to be dipped in the mixture, it being stirred the while, and left in the sun for the outer coating to dry. The white ant, it is believed, cannot get at the nut without partaking of the arsenic. It is here assumed that the coating of the mixture will resist the action of water, for, be it remembered, that planting usually is done in the S. W. rains. If arsenic be soluble in the water, I am inclined to think the mixture will be more effective without the sugar and flour, and if the plants, *i.e.*, the husk, be allowed to imbibe a portion of the mixture. I have heard alum mentioned as a specific for white ants. If the plants are allowed to imbibe alum and water with a dash of kerosine it may be good. To those with coconut plantations on the sea-borde, I would suggest the trial of a plan of a neighbour of mine. He filled a tub with sea-water and dipped his plants in it for twelve hours I believe. The remedy has the merit of possessing manurial value as well. Cattle, as an enemy, comes next in order, and is, I think, as destructive as any enemy, when it pulls out the toothsome cabbage or heart of the plant for a dainty mouthful. There is an end of the plant after that. Black beetle comes next, but it is I believe, seldom or never, that a plant succumbs to its attack. It is usually fished out with a barbed wire; but for its extermination the heroic remedy of hunting every "dunghill, every accumulation of decayed vegetable matter or rotten tree", is suggested. This will involve a never-ending, and therefore very expensive, hunt, with very dubious results. The last and least in size, though not in its destructive powers, comes the red beetle. It is placed last on the list because it is perhaps the enemy of the mature more than the young tree. It is said to have no alimentary apparatus in its perfect state, its sole business then being propagation. It deposits its eggs wherever it finds a slit in the stem of the coconut tree. The resulting grubs work their way into the heart of the tree. This work of destruction done, and when the term of existence as a grub is drawing to a close, they withdraw near the rind and envelope themselves in a cocoon made of that part of the tree they have destroyed, and await transformation. We are told that the coconut tree is in danger of this enemy from the time it perfects a stem till it commences to bear, although I have had trees attacked long after they have commence to bear fruit and yield crops. The cause generally is traced to the desire of planters to trim their trees to give them a decent appearance. This necessitates the pulling-off of all decayed branches and the exposure of the tender stem to the sun, which causes it to be split, and there the beetle lays it eggs. Occasionally a tree is said to be lost from an accidental wound or a defect in the arrangement of its leaves. Observation has inclined me to the belief that the beetle does not, as a rule,

go from tree to tree seeking an accidental wound or a slit in the tender stem where it may lay its eggs. If such a spot be found, it will no doubt be readily used by the beetle as a depository for its eggs, and save itself the trouble of forming one, which it invariably does. There is no remedy, we are told, for an attacked tree but to destroy it with fire. This is generally true, but occasionally a tree can be saved by cutting out a hole in the hollowed part of the tree, scooping out what has been destroyed with all the grubs and beetles it contains, and burning in the hollowed part any substance that will give a dense smoke. Immediately after, fill up the hollow with ant-hill earth and ashes saturated with kerosine and water or carbolic and water. Even this remedy fails except at rare intervals, but the vitality of the tree is impaired after the attack. I regard the red beetle as the most formidable foe of the coconut planter, and as destructive as all the other enemies put together. Means may be devised to circumvent the other enemies of the tree, as they carry on their work of destruction openly to a great extent; but the attacks of the red beetle are insidious, and very often the first intimation of its attack is the drooping head of your very best tree. The attacks of the other enemies of the coconut tree are in their early life, when the loss can be easily repaired by a supply; but this foe attacks a tree after it has escaped every other foe, and about the time you expect to reap the fruits of your labour and patient waiting. You cannot avoid its attacks; but I remember reading sometime back that a pound of salt placed between the topmost branches of a tree, just before the two rainy seasons in the year, is a specific, as the melting salt forms a crust on the stem especially distasteful to the beetles. Now we know that salt dissolves even without coming into contact with water, so that so highly soluble a substance is not at all likely to form a rain-resisting crust even of a few months' duration. The benefit of the application to me is more imaginary than real. I will notice the second part of the essay in another communication.

After a long interval I resume notice of the second part of the Essay on Coconut Cultivation which appeared in the *Tropical Agriculturist* for July. Before proceeding, I cannot but refer to your foot-note to that part of my previous communication bearing on coconut nurseries. Nine out of every ten natives put down their seed coconuts on their side, and very often the tenth one too does it. The system has advanced a great deal beyond the experimental stage, and does away with the necessity for trying it on a few coconuts as you suggest, and the benefit of the system are not theoretical but real.* In detailing the advantages of putting coconuts on their side in the nursery, I forgot to mention that it allows of the resulting plants being steadied when planted out, by two pegs put cross-wise over it, to overcome the displacement which follows the coconut holes being filled with water.

To resume. The "gratitude of the coconut for fertilising matter" is exemplified by the robust and green appearance of the trees in the vicinity of habitations. The native accounts for this by the love of the tree for the human voice, and not, we are told, by the manure deposited by the family and their domestic animals. The writer thinks that the lesson to be drawn from this is, that we ought to hasten the profitable period by artificial means. To my mind this is a short-sighted policy. The lesson I learn from the vigorous growth of trees near human habitations is the benefit of keeping a plantation already in bearing in good heart to secure remunerative returns.

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* From the absence of any reference in his last letter to the planting of coconuts on their sides being practised by natives, we thought our correspondent spoke of experiments initiated by himself; but on enquiry the very next day, we found that the practice was very common in the country, and we mentioned the fact in a subsequent issue.—Ed. "Ex."

The usual or goiya system of opening up a plantation is next discussed. The clearing of the land is done without any money expenditure by the proprietor; and in a favourable case, we are told, the land share of the secondary crop covers the cost of lining, holing and planting. I suppose this includes cost of plants as well, as it is said this system gives the owner his land planted free of all cost, except the purchase money and the interest on it. The plantation is then allowed to run into jungle for three years, "when there is the alternative of clearing the jungle or letting it grow on. and finally smother 90 per cent. of the plants, whereas if cleared in the sixth year 50 per cent. will probably be saved." A little complicated this for we are not told what percentage of plants can be saved by clearing in the third year, nor is the period of time in the expression "grown on" indicated. The exactitude with which the percentages of saved plants by clearing at certain intervals is given, is, I am afraid, not the result of any calculation. In the twelfth or thirteenth year, when the more forward trees begin to bear, the final clearing takes place. By the second period of neglect 10 per cent. more of the plants are lost. For the 40 per cent. alive, 10 per cent. will be in bearing, and "the remainder of all ages downwards"—whatever that may mean. Mark, again, the certainty with which percentages are given, without even the small qualifyng word "about." The annual expense of weeding and supplying is given at R12 per acre, and only about the twentieth year will the yield cover this truly moderate cost of upkeep, and even then 10 per cent. of vacancies "*will*" exist. "Thus the cost of bringing coconuts into bearing in the most slovenly and desultory manner will be R120, R30 of which will be recouped by produce up to the twentieth year." I fail to draw the same conclusion from the figures given.

The "effects of Lantana" are noticed next, and we are told that the above conclusions and figures hold good only if the land is of average quality and the jungle to be encountered indigenous; but if the Lantana has crept into it at the third year, and is not cleared at three years, not one coconut plant will be left at the seventh year. It would have been useful to have been told what percentage of plants would have been saved if the Lantana had been cleared at the sixth, instead of the seventh, year. I wonder if the experience and observation of the planters accord with the deadly powers given to Lantana, and with the statement that "the presence of Lantana in a clearing guarantees the extermination of every other member of the vegetable kingdom that depends on the first eight feet of space (?) for its air, light and sunshine." This statement, which everybody who goes about with his eyes open can refute, stamps the writer as a person of very limited observation. I have known coconut plants allowed to be overgrown with Lantana soon after planting, cleared not after three years, but after seven or eight years. To the surprise of the manager of the estate, he found a large number of the trees with flower spathes and commencing to bear, and not the deplorable sight of all the plants gone.

"Calculations of proceeds" I shall produce in their entirety, as the writer assures us that they give the history of more than one property under his observation during their whole life. "The average yield of average soil under the usual goiya system will be 1,000 per acre R30. There is R90 to make good, the interest on which at 10 per cent. is R9; The current expenditure is R12, and there is R9 over to be deducted if we value the proceeds at R30. Supposing the annual increase of proceeds to be R5, it will take five years to rub out the R90 that stood at debit in the twentieth year. Thus in the twenty-fifth year, the place is clear, and the annual average income will henceforth be R38 per acre, as long as the price keeps up at R30 the 1,000, and this calculation drops all the back interest in the original cost, as well as on current expenditure; from the twelfth to the twentieth year, which, if taken into account, would

leave from R60 to R70 to be made before the property was clear of debt." The Island boasts of a few financial experts. It will take the best man of these to correctly solve and tabulate the above very complicated problem. Unprofessionals like myself will, in sheer desperation, feel inclined for suicide or to run *amok.—Cor.* "Ceylon Examiner."

COCONUT-PLANTING:

AS PRACTISED IN THE LOWCOUNTRY OF CEYLON.

To resume, the calculation of proceeds of a coconut plantation according to the goiya system was last touched upon. The next paragaraph gives "another sketch of a plantation that was cleared and planted and allowed to grow into jungle for twelve months. At the end of that period the jungle was "ten feet high," with all the plants, less four, destroyed by wild pigs. One can but conjecture the damage done, as the acreage of the plantation is not given. The proprietor of this plantation, we are told, had much pluck and went to work the next year on a new system. He rooted out all the jungle at an expense of R20 the acre, and planted the land with manioc. The wild pigs fancied the manioc more than the coconut plants, and about 70 per cent. were saved. The vacancies were supplied twice a year, yet at the end of nine years they amounted to 10 per cent. During all these years the place was kept in order, and the pasturage was rich. At the end of the fourth year cattle were put on the plantation, but securely tethered against damaging the coconut plants. Before the place was five years old, 10 per cent of the plants had commenced to bear, and seventy-five per cent. of the plants treated with cattle manure were in bearing before the ninth year; its further progress cannot be stated as the place has not gone beyond the ninth year. The trees, we are told, that had commenced to bear three years ago will, allowing for all contingencies, yield on an average 80 nuts per tree, or 5,600 the acre, which at R30 the thousand, will give the handsome return of R180. The lucky proprietor of this model plantation, we are told, will not wish it to be known that he has spent over R200 the acre on the place, without the further fact receiving publicity, that by the end of the twelfth year he expects the yield to cover every penny of principal and interest, and give him a very valuable property besides. To which I may be allowed to add, that the proprietor must be a very sanguine man indeed, to calculate yield three years hence with such confidence and nicety. Instinct points to the writer of the essay, who never allows the small qualifying word "about" to disturb his calculations, and to this sanguine proprietor, as one and the same person. The only manure applied to the property was one-third of a ton of quicklime at a cost of R7·50. The high expenditure was owing to every work being experimental and the soil being rich, which of necessity made weeding, etc., heavy. A portion of this property, which received similar treatment to the rest, but did not receive any cattle manure, is so backward in growth as not to show even stem as yet. This to me, does not speak much for the soil. Fancy trees nine years old not shewing stem as yet! But they are to receive yearly doses of poonac till they come to be forward plants.

We are next told how an old plantation 21 years old and with a poor sandy soil was treated, and how it responded to the treatment. The largest crop it had given was at the period named, and it averaged 13½ nuts per tree. A new manager assumed charge at this period, and submitted a scheme which added 10 per cent. to the annual expenditure. It was at first opposed, but finally allowed. As a first step all the pigs were disposed of, as also one-third of the cattle. The rest were allowed free access to the poonac tubs and had a roomy shed allowed them, which was daily littered with jungle stuff and ferns from the low grounds on the estate. When the rains commenced, all the manure that had accumulated was carted and spread on

the surface of the ground at the rate of $2\frac{1}{2}$ cubic feet to each tree, and dug in with mamoties. Not much could be done in this way, as it would have then 12 years to go the round of the estate, while the effects of the manure last only three years; but, as a result, the average yield per tree went up to 21 nuts in six years. Steamed bones were next used, of which two tons were allowed annually, with the result of the yield running up to $33\frac{1}{2}$ nuts per tree in the eleventh year. The estate next fell into the hands of natives, who allowed the yield to fall to twelve nuts per tree. The whole cost of manuring the 18 years was R1 per tree, and the result over R3, giving a return of 300 per cent. on the outlay. We are authoritatively told that if five times the amount had been expended, the results would have been proportionate.

The next paragraph is a small lecture on Chemistry, and tells us that the writer looks upon the coconut tree "as a chemical apparatus for turning carbon, oxygen and hydrogen into oil." Plants draw the whole supply of these elements from the air, therefore no quantity of oil removed from a given area of land impoverishes the soil. But to make oil, the coconut tree must needs grow, and to grow, it draws from the soil nitrates, phosphates and alkalies. If oil only is removed from a land, and all the other products of the coconut tree returned to it, the average yield of oil will never decrease as long as the tree is in health. Introduce outside supplies of nitrates, phosphates and alkalies and the yield of oil will increase and the soil be improved. I trust your readers appreciate this little, simple lecture.

We are next told to "replace fertility removed," which is very good and sensible advice, but the process of calculation is not so easy as one could wish. "Ascertain the average of the fertilising elements removed in a given number of nuts and set aside such proportion of the price as will replace them." Rather a difficult calculation I should say. The surest way is to manufacture oil and to retain the poonac, but if the crops be sold as gathered, the planter must know exactly how much "nitrate, phosphate and alkalies are in a candy of copperah, and their prices," so as to purchase such fertilisers for application to his land. Beautiful in theory, but difficult to practise. One hundred and fifty pounds of poonac, we are informed, will replace the fertility removed by 1,000 nuts, so that that is the cheapest and best manure for coconuts especially if passed through a cow.

The manure resulting from cattle only grazed on a land does not add to its fertility, but it is of great importance that such manure should be placed at the roots of young coconut plants which do not go far in search for food, as aids to rapid growth and early bearing. The benefit the plants will derive will not be only from the food thus placed within their reach, but the roots will be stimulated to increase their feeding ground. It is more beneficial to give small and frequent doses of manure to a tree than large doses at long intervals. The manure must be buried below the surface. When planting, put in each hole a couple handfuls of lime and a pound of poonac. A tree cannot be expected to yield two or three rupees annually, unless its constitution is built up. The writer of the essay, whose dicta the above are, will spend fifty cents per tree during the first seven years "in building it up," after which, within four years, it will give a return of three nuts for every five cents of manure used. Mark the confidence and certainty with which results are given. The manure and its price too are known quantities in the calculation. There is no practical limit to the yield of a tree; the writer of the essay is acquainted with trees bearing from 200 to 400 nuts each annually for a series of years, but that is owing to the "individuality of the tree" and suitable soil. The contention of the essayist, which nobody ever did or will question, is that any tree bearing a small crop in any soil, can be made to increase its yield. "A good soil gives a good crop without assistance while a poor one gives a poor return, but the one will respond to manure as readily as the other." Here the essayist delivers

himself like a practical planter and not as usual as a theorist; but he has forgotton one little question, which every practical planter who has a regard for his own or his employer's purse will put, before he undertakes to increase the yield of "any" tree on "any" soil—"Will the increased yield cover the cost of inducing it?" That is a safe test to apply to all such undertakings. I am afraid no practical planter will accept the next statement that "the same amount of manure will result in the same addition to the crop, whether the trees to which it is administered have previously been bearing ten or fifty nuts per annum."

The next paragraph deals with "the treatment of a single tree and results," and opens with the startling statement that a stem of a coconut tree on poor land forms a complete register of the periods at which manure had been applied, the effects it produced, and the time during which it operated and became exhausted. How the appearance of the stem of a coconut tree could indicate what crops it bore when manured, for the *effect* of manure is always gauged by the resulting crops, and the period of time the crops were affected by the manure, passes my poor comprehension. [The effect on the stem is obviously meant.—ED. "Ex."] It is well known that on poor soils, neglected coconut trees gradually taper towards the top. A little attention, not necessarily manuring, causes the stem to bulge out again, so that a practised eye could easily detect if a property had been neglected for any length of time and taken in hand again. But for any one to say he can give the effects of such renewed attention, or name the period of time the improvement consequent on such attention lasted, is rubbish.

Now for the account of the tree that yielded astonishing results by the application of manure. The tree existed for twenty-five years on such poor and sandy soil, as no other form of vegetation would grow on. The stem was one foot in diameter at the base and tapered to four inches at the five feet to which it had attained. The leaves measured about thirty inches. No worse specimen of a living plant could be selected, but it was operated upon for the sake of experiment. Twenty pounds of poonac and five pounds of steamed bones were mixed and dug in round the tree in a circle twelve feet in diameter. The growth was vigorous, and within a twelve month the new leaves had attained a length of fifteen feet. At eighteen months the first flower shewed itself, and the tree again received five pounds of poonac and two of bones. At thirty months it began to give a crop so heavy that fears were entertained of the stem snapping at the thin portion. The same dose of manure was given for the three succeeding years. At the end of the fifth year the wretched specimen had developed into a handsome tree, with the stem at the top over one foot in diameter, and carrying a crop of 60 to 70 nuts, while the previous crops aggregated over 100 nuts. According to the writer, this handsome tree was built up and yielded 170 nuts, with an expenditure of only 75 cents for the 40 lb. of poonac and 13 lb. of bones applied over a period of five years. A very handsome return indeed, and a fit reward for five years of patient attention to a tree described as "the most wretched specimen of a still living plant." How many owning trees answering to this description will feel cheered by this experiment, and be inspired with hope! After this no one will deny the essayist the right to raise himself on a pedestal of his own making, to assert his own superiority over his brother-planters, and with a feeling of pity for their ignorance to address them thus:—"There are truths that science has made common property, but which few coconut planters have yet asserted their right in, or indeed become aware of, their existence. How few of them know that 187 lb. of poonac contains (*sic*) all the elements that is (*sic*) removed from the soil in a candy of copperah? How few of them know that the poorest soil may contain some of the elements of fertility that the plant cannot assimilate from the absence or deficency of other necessary elements? A few measures of quicklime may bring into activity a great fund of latent fertility; a few ounces of bone dust may be the one thing wanting to put a good crop on a

barren tree." A sigh of pity is next heard for the poor ignorant goiya, who, we are told, would pronounce the principles of Agricultural Chemistry, if propounded to him, a myth, and the propounder a humbug. No general knowledge of Agricultural Chemistry, is possible till the Agricultural School turns its graduates "loose on Society." Next comes a fling at Europeans, of whom "not half a score know anything of coconuts." Then an all-round thrust at proprietors, who, though educated and intelligent, will not deign to look on the scientific aspect of the culture.

I am not one of those who hold it as "an incontrovertible rule" that coconut plants not in bearing should not be manured. What I hold and practise is that laggards should be stimulated and fed to keep pace with the other plants in a field. But I am most decidedly of opinion that plants showing satisfactory and fair growth should not be stimulated into early bearing *if* you wish your plantation to be a permanency. Experience and observation alike teach us that precocity and longevity are not synonymous, but opposite, terms.—*Ibid.*

THE COCONUT PALM.—The king of low-country products is, of course, coconut. What coffee was to the hill country coconut is to the sea board districts. Indeed, it may lay claim to the sovereignty of the whole Island; for the aggreate value of all the varied products of the coconut tree exported cannot, we feel sure, be of greater value than those consumed locally in the shape of food, oil, poonac, thatch, coir-goods, fuel, timber and articles of domestic use. [The proportion of local consumption of products of the coconut (as well as of the palmyra) palm must be immensely greater in value than the export.—ED.] If coconuts never gave proprietors the magnificent profits which coffee at one time yielded, they never, on the other hand, involved them in magnificent losses. Not that coconut cultivation has not its enemies, like other products. White ants and porcupines and wild-pigs are, at times, formidable to young plantations, and so are beetles and lightning to established ones; but history refers to no scourge which ever devastated coconut plantations in the way that *hemileia vastatrix* ruined coffee estates. No natural laws are violated in its cultivation, for the tree is allowed to grow at its own sweet will, without being hacked and hewed to promote fruitfulness, and Nature makes return in longevity and regular crops. These may further be regarded as the reward of patience, and the subjection of the desire to hasten to be rich. Thus has it come to pass that coconut estates have long been regarded in the light of a safe, if slow, investment, as distinguished from a speculation; but, we fancy, during last year, proprietors of estates in full-bearing derived an income from them larger than any other island product has yielded, The oil shipped up to the 30th ultimo aggregated 424,090 cwt. against 306,000 the previous year, and only 184,000 in the year 1881-82. Not only are the shipments far in excess of those of any previous year, but the prices which have ruled—about £30 a ton on an average—although only about 2-3rds of the figures reached in the fifties—have given satisfactory profits to the grower. It does seem strange that an oil locally produced in abundance at small cost, should be superseded by an imported article brought thousands of miles in secure packages; but it is yet the fact that kerosine has largely displaced coconut oil, not only in households in towns, but even in many of the villages among natives. Nothing is more common than to see villagers returning to their homes by trains or on foot with attractive little kerosine lamps and bottle of the cheap oil. For reading, coconut oil is decidedly preferable, as giving softer and cooler light it has also the advantage of standing gusts of wind better than its mineral rival—but it cannot be compared in cheapness with the produce which the bowels of the earth yield in such plenty in America and Russia. It is not, however, for lighting purposes that coconut oil is chiefly exported, but to be used in the manufacture of soaps and lubricants, and to some extent of candles; and for these the demand will continue.—*Ceylon Examiner*, Oct. 1883.

DRAINING OR TRENCHING FOR COCONUTS.

TO THE EDITOR OF THE "CEYLON EXAMINER."

SIR,—It does seem strange that so necessary a branch of the proper and husbandmanlike cultivation of the coconut is so universally neglected. But then the coconut is seldom systematically cultivated, it is simply allowed to grow. Weeding a coconut estate generally receives the exalted term of cultivation, and if a man more intelligent or less apathetic than his fellows acknowledges the necessity of giving back something to the soil for all he is taking out of it, and manures his land, he is supposed to go in for "high cultivation." The coconut receives fair and generous treatment only on such poor sandy soils as refuse to give up elements of fertility they do not contain; and absolute necessity is made a virtue of.

Now to my subject. Trenching is taken up by some to prevent "wash." by others not to be behind-hand with their neighbour. We unhesitatingly assert that there is absolutely no *wash*, in the general acception of the word, on a well-grassed land. The soil is so firmly bound by the roots of the grasses, that not a particle can be displaced by wash. The grass filters and arrests all soil held in solution, even in water rushing from the side drains of roads, wherever such bound grassed land. I had an opportunity of witnessing this while travelling once on a road during a heavy rainstorm. A large stream of water washing through and over a road, found an outlet in a thick and muddy condition on a coconut estate skirting the road. Before the water had gone twenty yards, it was flowing as clear as if passed through a filter! Droppings of cattle, even when dissolved by rain, rarely travel beyond a foot of where they were deposited. The only part of a coconut estate where rainwater carries along with it any loose soil or decaying vegetable matters, is in a hollow or ravine, and this is owing to the accumulation of water from all sides towards this hollow. Careful trenching, by arresting water before it reaches a hollow, can avert even this slight amount of wash.

Those who resort to trenching to arrest wash throw the soil dug out of the trench on the upper side of it. The absurdity of this becomes apparent with the first heavy rainfall, as the trench, not being traced at any gradient or even level, the accumulation of water wherever there is a depression, causes the earth work to give way, and the rush of water in a volume does all the damage tenfold increased. which trenching was thought to prevent. Every successive rainstorm widens the breach and wears away the earth-work. But it will possibly be told that this soil carried through the breach is caught by an ingenious contrivance for a silt trap, designed and used by certain planters, consisting of a fence of live sticks put down at every trench and protected by rubbish and the branches of the coconut. To my mind the game of digging trenches so that the soil thrown up above it is caught in a trap below it, is more expensive than ingenious.

If there be no wash on a coconut estate, where is the necessity for trenching? Not to mention the benefit to a soil in its aëration and increased porosity resulting by a system of trenching, it has the additional merit of storing up and slowly dispensing to the coconut the moisture it revels in, and which is so much of a necessity to mature its nuts. It is not necessary for me to assert that it is more beneficial for a soil to have rain water stored at intervals and slowly filtered through it, parting with the fertilizing matter it holds in solution, than for it to wash over a soil. Saturated as such a soil is with water, it will be better able to stand a prolonged drought, than if the water had passed over it, without saturating it to any appreciable extent. I would not cut trenches, as I have always seen done, over long unbroken lengths and to a great depth; and for these reasons: Trenches are cut between the lines of coconuts, and these do not invariably run at right angles to the slope of the land. Consequently, all the water

accumulates at the bottom of a slope, and finds an exit there, and only those trees are benefited where there is an accumulation of water, while it becomes a question whether those at the top are not in a worse plight than before, by having all the moisture, that otherwise might have been there, drained from the roots. And I will not have trenches deeper than a foot or eighteen inches, as the water caught in trenches three or four feet deep is likely to sink beyond the reach of the roots, for, remember, except in very free soil, coconut roots are seldom found below eighteen inches. Deep trenches are likely to drain off too quickly the moisture in the soil. It is best I think to cut trenches in sections of say twenty-five feet, making the bottom as level as possible by cutting deeper where the land is high and less where low, and throwing the soil on the lower side. The advantage of cutting trenches in sections is that each section holds whatever water falls above it, benefits the trees adjoining it both above and below, and does not allow the water to flow down to the bottom of the slope and be lost. It is also necessary to fill the trenches with all the droppings from trees and with weeds, both to prevent too rapid evaporation of moisture, and as manure for the trees, opening new trenches between the old ones as the latter fill up.

Yours truly,

AGRICULTURIST.

GUINEA GRASS ON COCONUT ESTATES.

(By a Planter.)

The advantages derived from extensive cultivation of guinea grass—independent of the saving of the expense of grass-cutters, and of outlay for straw, &c., and of the ability to fatten pigs, cattle, &c.—are many. Among them I may mention:—

I.—Enough cattle can be kept on an estate to admit of ploughing the estate, *quickly*, whenever the ground has been caked by rain and drought; of dividing such produce, manures, &c., as we desire to cart, without anxiety.

II.—Ground can be ploughed as it may be deemed advisable to do so without necessity of considering where the cattle are to graze.

III.—Cattle can be kept, simply for manuring purposes, without fear that every blade of grass consumed by them is taken from the mouths of working cattle.

IV.—Cattle can be stall fed, and thus working cattle can be kept in better condition than when their leisure hours are spent in ceaseless endeavours to pick up a precarious subsistence on the scanty herbage during the dry season.

V.—By means of stall feeding manures can be prepared in the highest state of perfection. Liquid manure tanks can be kept in use, &. &c.

I do not mean to say that guinea grass would alone be sufficient or suitable feeding for *working* cattle: They require *nitrogenous* food for the pupose of repairing the waste of muscle and sinew arising from labor. Such food as poonac is necessary when we requre a good day's work or a continuance of it.

Cattle will return the poonac as manure in a *more highly nitrogenized* condition.

COCONUT CULTIVATION IN CEYLON.

(From the *Overland Ceylon Observer*, April 30th, 1862.)

Though the coconut has a pretty wide geographical range, and has been considered a most important plant in every country in which it grows, it would appear that it has generally been accepted more in the the light of a gift of nature, than an object of human art and industry. Ceylon is the only country in which the cultivation has been attempted on a scale of sufficient magnitude to render the habits of the plant the subject of professional study to men of intelligence, and here, within the past twenty years, a fund of experience has been accumulated, of which it may be hoped the world will not lose the benefit.

A new agricultural undertaking labours under serious disadvantages in the most favourable circumstances, but coconut cultivation when first entered on as an investment for capital in Ceylon, had to contend with drawbacks peculiar to itself. Those who are new to a country and its productions, cannot be expected to possess a critical knowledge of soils and localities, suitable to a proposed cultivation; but in the case of many tropical productions an original error may be remedied. Plants of one or two years may cause loss of time and money, when they fail, but the capitalist and the planters are not bound to continue the struggle. The coconut, however, is a plant that takes from ten to fifteen years to answer the question that the planter puts to nature through it, while it is expected to remain a source of profit for three-quarters of a century; if therefore its cultivation be undertaken in ignorance of the conditions of success, a primary mistake is the parent of a life-long battle, where subsequently acquired experience, scientific knowledge, and doubtless industry will barely enable the planter to hold his own ground.

Those to whose lot it fell twenty years ago to select land for this cultivation, were unfortunately for themselves, and the progress of this branch of colonial industry, profoundly ignorant of the subject. The plant was found flourishing on the sea-shore; therefore sand was its natural habitat. It was said to be possible for the plants to yield fruit in the seventh year; therefore a large plantation was to be generally in bearing at the end of that time. The price of waste land was known, the price of clearing light jungle was known, and the other expenses were estimated at a mere trifle. The cost of a coconut property was thus to be a sum scarce worth mentioning; while the annual produce per tree was taken at the very highest rate that could be heard of in the best native gardens, so that a very excellent case was made out in favour of this as a paying investment for capital. For the first seven years things were hopeful, though the estimates of expenditure had been exceeded, and the plants were not yet in bearing, and it began to be said that the bearing in seven years was a mistake. Still there was hope; but as years passed and the plants were only found to struggle into bearing, and to yield a much lower produce than that calculated on, it was gradually admitted that coconut planting was not to be the first class investment that it had been originally given out to be. Years after the tone of the planters has saddened down, till culture and manure have now become his only hopes. The case is bad enough as it is, but it would have been still worse, but for a circumstance that could scarcely have been foreseen twenty years ago. The price of coconuts has risen eighty per cent in the last fifteen years; this has not only saved the older estates from ruin, but will probably give a fresh impetus to the cultivation, both in the improvement of existing properties and the formation of new ones. The owners of the former may take for encouragement the fact that no plant responds more gratefully to anything done to improve the soil in which it grows, while those who now invest their capital, need not choose their locality without consulting those whose experience can point out the best, or at least the lands that are

naturally suited to the cultivation. There is an old proverb which says: "He who is his own lawyer has a fool for his client." He would be no less a fool who would purchase land for coconut cultivation, without learning all that science and local experience has already done, in the discovery of the conditions on which nature will respond to the call made on her by the cultivation.

It would hardly be possible to overstate the importance of the selection of land for coconuts. It is possible to point out land planted twenty years ago, on which the few trees that still exist, have stems two feet in height and leaves from two to three feet in length; as for yielding fruit at any future time, of course, that is a thing out of the question. There are other spots where trees several years younger, and for which nothing has been done but what was absolutely indispensable, yield average crops of 100 nuts per tree. Between those two extremes there may be found every degree from utter failure up to one of the best paying investments into which capital could find its way, and all depend on bringing to the task a competent knowledge of the value of soils, founded on the signs which nature has impressed on them. In acquiring this kind of knowledge there is no great difficulty, to an earnest mind, in a country where the plant is to be found growing in every kind of soil, of every age, and under great variety of treatment. A man needs only a watchful eye to observe facts, and a reflecting mind to turn them to use. A habit of looking up at the tree and down at the soil, will, in process of time, enable him who practises it, to give the true value of every shade of colour, every degree of inclination, every difference in composition or consistency that may come within the field of his observation—some knowledge of botany, chemistry and geology will be an indirect aid in the practical study of the value of soils, from the habit of minute observation which they demand; but a pocket case of reagents, a dried herbarium, and a geological hammer, are not the proper tools for the work. It is only experience that will avail, and the experience of a keen observer, and a close reasoner too.

Whatever may be the case in other countries, the coconut requires an average temperature of not less than 80 degrees in Ceylon. I have myself made the experiment on a coffee estate, at an elevation somewhat under 300 feet, and where the average temperature was 75 degrees, and the range throughout the year only 10: the soil was of the very finest quality, yet at the end of two years, the plants had made less progress than those planted at the same time, in the same district, and with no advantage other than a lower elevation, and consequently a higher temperature, made in six months.

As far as my experience enables me to judge, the advantages of sea air to this plant are generally over-estimated. Where a suitable soil and temperature are to be found the only consideration should be the cost of transport. I have no doubt that to the north of the mountains, coconut could be advantageously grown, right across the island, from Puttalam to Batticaloa. Perhaps, however, the best districts to seek land in at the present time, are those between Matara and Hambantota on the South Coast, and between Negombo and Puttalam on the North-West. The tract of country that lies between the central mountains and the South-West monsoon is too wet, and the North-East Coast is probably too dry. It is unnecesary here to enquire into the causes of the poverty of the lands on the South-West Coast, the fact must be admitted by every one who has given any attention to the subject. The ridges are dry hot gravel washed by the rains for thousands of years. The flats are either clay, always cold and retentive, often swampy; or loose sand so poor as to be almost void of the elements of vegetation over considerable extents. It is not to be denied that even in the worst districts, pieces of good land

may be found, but they are few, of small extent and wide apart, at the best. After passing Negombo on the one hand and Matara on the other, the character of the soil gradually, but decidedly improves; the ridges become less gravelly, the clays less stiff, and the sands more loamy, while the colours become deeper and darker in each case. It is true that as the soil improves the climate becomes less and less healthy, but this is one of the penalties imposed on mankind in their task of subduing the earth, and is not such as to deter skill and labor from runing alln risks if capital be forthcoming. Experience proves that fever deserts a highly cultivated district, and those who face it during the transition period, should be prepared with all known means, wheti er preventive or remedial, to counteract the effects of the polluted air.

In any land with the exception of a cold retentive subsoil, it is possible to obtain annually from one acre 10.000 nuts by heavy manuring and high cultivation. But it is evident that this will take less manure and less labour in proportion to the natural fertility of the land. The question in selecting lands is not what may be done by manure, but where the natural oil will do without it. I have already said that lands have been planted in their natural state that would not even grow the plant, and that almost without cultivating I have known land yielding 5,000 nuts per acre. In the one case a new soil would have to be made, and enriched with all the elements necessary to the coconut, before reaching the point of the fertility from which the other starts. As to the making of a soil, let it be remembered that 135 cubic yards of material will only raise the surface of an acre of land one inch, so that blending the old and new material into a soil six inches deep would require above 400 cubic yards of the latter. The cost will be calculated from the local price of labour and the distance from which the material had to be brought, but the cost would be something pretty considerable under the most favourable set of circumstances, and a mistake as to the value of the material applied would render the whole of no avail. It may be safely asserted that the mixture of two poor soils will not make a rich one, but they may often make an improveable one, while neither of them is so separately. Heavy clay laid on sand or gravel will only improve the constitution of the soil so far as to render manure applied to it more effective and more lasting in its effects. Even if the mixing of materials to form a soil were proved to form a fertile one, and the operation a paying investment, we of this generation have nothing to do with it in the formation of new properties. whatever we may do in the improvement of the old. Let us seek out first class lands now, such as nature has constituted suitably without our aid, and leave our great-grandsons to make the most of the second and third class, when free governments and free trade have doubled the population of the civilized world and quadrupled its purchasing power.

The great drawback to coconuts as an investment is the long period that must of necessity elapse before any return is obtained. During ten years money is always going out and nothing coming in, so that when a property does begin to pay, it has not only to yield the usual profits of capital but bridge up a long leeway. To obviate this drawback, native proprietors are in the habit of exhausting the land by secondary cultivation, while the coconut plants are young, and this is continued as long as anything can be obtained in return for the necessary labour. The disciples of Liebig need not to be informed that this custom would be more honoured in the breach than in the observance. The natives, however, cannot understand any connection between the failure of the coconuts and the crops of grain, roots or fruits that they have taken off the land. The enlightened cultivator chooses land that when his trees bear will yield him 3,000 nuts at the very least per acre annually. He makes up his mind to an expenditure of from £12 to £16 per acre, before he can obtain a single penny of return, and he resolves to return to the soil a full equivalent for

every ounce of produce he removes from it. These plans carried out in in their integrity will ensure an annual rent of £6 per acre for a period not less than half a century. On the other hand if a man becomes involved in the cultivation of inferior land, he may have to struggle through life to make a living out of it; if the cost has been miscalculated the property may be brought into difficulties not to be surmounted; or, if he should lose his confidence in the undertaking, he may sacrifice all his labour, to the making of the fortune of some one, whose pluck is backed by ready money.

BY A WESTERN PROVINCE PLANTER.

(From the *Overland Ceylon Observer*, May 30th, 1862.)

When land is once purchased with a view to cultivation, the owner need speculate no further: when he has made his selection, skilfully, he will have nothing to regret in the future. I have already intimated my opinion, that any one wishing to purchase coconut land may, if he will take the proper means, secure what is suited to the purpose, and if it turns out otherwise he will have no one but himself to blame.

Though an allotment of land may have a general character, it is perhaps impossible in any part of Ceylon to find 10 acres together of uniform quality; a wise man will, therefore, give the closest observation and the deepest reflection, he is capable of, to the appropriation of the land, before he puts a plant in it. He will mark off the portions to be left unplanted for the present, and after clearing the part he proposes to cultivate, he will select only the finest pieces for coconuts, leaving aside the inferior quality for pasture, It has always appeared to me one of the greatest errors of our early planters, that they have generally planted up the whole of their available land with coconuts and left no resource for future improvement; yet there is no truth better established than that manure will, when applied in sufficient quantity, double and even quadruple the natural produce of the land, and it is well known too, that the same manure which will double the fruit of a heavy bearing tree, will have comparatively little effect on a barren one. What good will it do me, however, to know that I may increase the produce of an acre from 1,500 to 6,000 by the use of manure, when I have no manure to use.

Let us take the case hypothetically: say I have 500 acres of land, which it is my wish to make the best of as a coconut field, say that my reasonable prospect from this land, when it comes into full-bearing, is 1,000,000 nuts per annum, if I plant it all up; but if I have a full command of manure, I can take 2,000,000. I know, however, that if I plant my land right through I have no means left of manufacturing enough manure to cause any increase on the permanent produce. On a detailed examination of my land I find that 100 acres is of a quality to yield naturally from 3,000 to 4,000 nuts per acre, that 250 will give an average of 2,500 and the remaining 250 acres, the natural produce of which will be 725,000. I clear the remaining 250 acres and make a cattle run, on which I can keep 170 head of cattle. This will enable me to commence manuring from the very first, to force forward the lagging plants, and to bring the whole into bearing two years earlier than if left to nature. Instead of straggling into bearing during a period of from 10 to 15 years, my trees will come into full-fruit simultaneously over the field, and with my means of manuring I will have every acre wrought up to an annual yield of 4,000 nuts in the 12th year; the same system continued will bring it up to 6,000 by the 20th year, nor will the improvement cease even then, for every particle of fertilizing matter brought into my land is a permanent gain, while I remove none of its products but the oil.

Chemists tell us that the elemental constituents of coconut oil are carbon, hydrogen and oxygen; and vegetable physiologists tell us that growing plants decompose water and atmospheric air to obtain their supplies of those elements. As the supply, therefore, is inexhaustible,

removal of coconut oil in any quantity does not tend to impoverish the soil. Let me restore to my land the leaves, husks, shells and poonac, in some shape or other, and keep it up to the same degree of fertility for ever. while all that I introduce from beyond its own boundary, adds to its fertility, either in furnishing direct food to the plant, or improving the texture of the soil.

Though I believe in the soundness of the above views, I would not have it understood that I have seen them brought to the practical test. It would take an average life-time of earnest perseverance in one unchanging purpose to place them among ascertained facts. but several years study of the character and habits of the plant has fixed an idea that was floating about in my mind long before I had any practical experience of this cultivation. If I should live to carry through certain experiments I have now in hand, I will be able to throw a steadier light on the subject.

Management of Cattle.—There was a breeding stock of cattle placed on a coconut estate when the trees were eight years old: the number at first was under 40 head, but by the twelfth year they had bred up to 401 head. During the subsequent eight years there was an average of 30 calves produced annually, there were none sold and none draughted off into the working stock, but the number never rose above 150 nor fell below 130. They had bred up to the limit of their food and the deaths of necessity balanced the births; about 75 per cent were calves within the first fortnight and the remainder the old and feeble. About the middle of the 20th year the number of stock was 145 head bearing the aggregate local value of £130. In the course of the 21st year, 50 head were sold for £60 and at the end of it 115 head remained of the aggregate local value of £150. The only object in keeping cattle in this case was the manufacture of manure, as it is on all estates where the number kept is greater than those necessary to do the draught work on the place: but there was a false principle acted on throughout, namely:—"The more cattle the more manure." This is only false relatively, for it is true of stock so long as is kept in full-feed, vigorous health, but it is false when we put three animals to pick up a livelihood where there is only food for two healthy individuals.* The above facts show that while £30 per annum might have been added to the proceeds of the estate by the sale of cattle that was thrown away in a baseless endeavour and a futile one to get more manure than the produce of the land would yield. The result of a change of system was that a greater bulk of manure as well as a better quality was produced from the reduced number of cattle, than had ever been made on the property in a like period before, and from its superior quality it produced more effects on the coconuts where it was supplied.

The first object then is to regulate the number of the stock in strict accordance with the means of feeding it. The experience of centuries has put a proverb in the mouths of the graziers of the South-West of Scotland, "under-stocked land may pay, but over stocked never will"—and the fact is as much a fact in Ceylon as in Scotland. Let us proceed on sound principles and we will always come out of our enterprises at the right end. Our experience may not extend everywhere, but let us creep before we attempt walking. A neighbour of mine, the manager of a coffee estate, had planted his ravines with Mauritius grass. It soon grew far beyond the consumption of his single milk cow, and he gave £75 for forty-five head of coast bullocks. In six weeks there was scarce a green blade left: in three months forty head of cattle had died. In three months more the grass had once more passed beyond its bounds, and a fresh stock of forty head was purchased; in nine months the whole stock was reduced to fifteen head which it should never have exceeded. I had another

* "Hullo!" said one Yankee farmer to another, "what are you fencing that land for? A cow would starve on 40 acres of it."—"Yes, I know that, and so I am fencing it to keep the cattle out.—Compiler.

neighbour I lived beside for ten years, who had the means of feeding thirty head of cattle, but he regularly during all that time purchased whenever he could get them cheap, and for anything I know continues the same to this day. On the other hand I have known a breeding stock of cattle kept for seven years without a single death among it and I have known one instance and one only in Ceylon of cattle feeding being made directly profitable. The process was to purchase lean but healthy animals, stall feed them for three months and then sell them to the butcher. This system is peculiarly suited to coffee estates where the means of feeding is confined to Mauritius grass in the ravines; but a breeding stock is most suitable to natural grasses provided the number be kept strictly within the amount of food that the land produces. The most that can be expected of such a stock is that the sales will cover the outlay connected with it, and the draught stock be kept up from the breeding stock instead of by purchase.

The first means of preserving a cattle stock in health is full feeding. Epidemic diseases almost always originate among the weak and half starved, and though it may reach the healthy and well fed by contact, it is less fatal and spreads less rapidly among these. At one time there was almost an annual murrain among the draught bullocks on the Colombo and Kandy road that swept them off in hundreds. For the last seven years such a thing as murrain has scarcely been heard of on the roads, while thousands were taken off in the villages. The cause of this is evident, the large strong coast bullock has superseded the small native breed on the roads—the former represents from three to six times the capital invested in the latter; the former are trained from their calfhood to dry strong food; the latter refuse everything but green food and prefer picking it up for themselves. Fresh grass alone does not communicate the stamina to stand hard work even when it can be had in abundance, so wet weather and heavy roads fit them for disease. On the other hand when food is scarce, an insufficient supply is equally productive of the conditions that induce disease. The owner of a coast bullock cannot afford to starve him, as he costs from £5 to £12, and immediately falls off in condition and in strength unless he gets dry straw, poonac and kollu, and is regularly rubbed down and washed and in fact treated with as much care as a valuable horse. The cattle now generally employed on the roads are fine strong well-fed and well-tended animals, some of them within my knowledge costing £25 per pair; and while this is the case the occurence of a serious murrain on the roads is among the least probable of possible contingencies.

Besides being full fed a breeding stock should be dry housed: they want protection from heavy rains, chilling night dews and the midday sun. The working stock should be well and strongly fed at whatever cost. Paddy-straw, if to be obtained, is the best when supplemented with as much poonac as they can consume. If paddy-straw is not to be had, guinea grass hay must be provided grown out of the coconut field, if there is any spare land, if not as may; for that or an equivalent must be had in proportion to the demand. Where poonac is produced on the estate the young cattle should be taught to eat it from the first. A handful of salt thrown into the trough or tub will generally be sufficient inducement; it is often much harder to break a young bullock to a new kind of food than to the yoke when an early beginning has not been made. The working stock should be rubbed down daily with dry straw or a coarse cloth and well washed at least once a week.

If there is both a breeding and working stock kept, the oldest of the latter should be sold off as young ones grow up to supply their place—the best age to sell at is seven years, because the animal is then in his prime and has still a great deal of work in him if well cared for. A working stock of 40 head will be kept up by breaking in 10 three-year-old every year and selling ten seven-years-old.

MANAGEMENT OF THE CATTLE MANURE.—Every one believes in cattle manure; we have our hypotheses respecting other fertilizers, but for this we have proof positive. Not a coconut planter in Ceylon but will readily own that if he could create a supply of this article equal to his wants, he would no more complain of obstinately barren trees and generally small crops. He would go on rejoicing and, like *Publicola*, double his produce every year. The supply is however in every case limited by natural barriers, and the most skilled can do no more than turn to the best account so much of it as his circumstances furnish him with, after he has made the most of them.

The food eaten by cattle contains most of the elements of vegetation if not all, and in the process of digestion there is withdrawn by assimilation, carbon, hydrogen and oxygen with small portions of the salts and phosphates; but there is added bile, pancreatic juice, mucus, and other animal matters to the dung, while the urine is said to contain no less than 21 ingredients, many of which are the bases of acids, all are soluble in water and all are direct food for growing plants. Turned into the ground fresh, there is no doubt that the dung and urine of cattle will produce a great and immediate effect on the plants, with the roots of which it is brought in contact, but this is only a better mode of applying it than letting it accumulate in a dry cattle shed without litter till it is a foot thick and trodden as hard as a brick, or throwing it out in a heap to roast in the sun several months. We should, however, avail ourselves, to the utmost of our means, of the property of cattle manure through which it reduces by fermentation ten times its own bulk of fresh grass or succulent weeds, five times its own bulk of dried litter or leaves, twice its bulk of inert rotten wood and three times its bulk of fresh peat. Every coconut estate will afford a greater or less supply of annual weeds: in most neighbourhoods there are swamps that grow coarse grass or fern, some will have the command of rotten wood and some of a peat bog; but in the absence of all those resources any one may fall back on the leaflets of the coconut tree itself—anything is better than to lose the advantage of that property of the manure by which it fits an inert and otherwise useless substance for the food of plants.

I have under my charge a coconut estate of 300 acres of age and to be in full bearing, but its annual bearing is only 350,000 nuts or 1,160 per acre, *Publicola* would say that the avowal is not creditable to me, and it would certainly be true if my incumbency extended over a sufficient time to produce an effect; but how much can be done in twelve months when a new comer has to study his resources and the existing system of management before he can take action in applying the one or superseding the other? The resources that had for twenty years been utterly neglected were a cinnamon garden of nearly 500 acres that in the state in which it was kept would have supplied little enough for 500 head of cattle, and nearly 100 acres of swamps and low jungles, some parts of which might be made grazing land, others would supply litter and the very worst would furnish mud and clay to improve the texture of poor sands. But roads had to be opened before any of those resources were available, the system of internal cheap and inefficient management had to be changed, and more money had to be expended in every direction. A manager of less than twenty years' standing can tell that a large and sudden increase of expenditure is not the direct road to the hearts of nonprofessional agents and proprietors, therefore a liberal system of expenditure should be made to come on them like old age, till a return for it begins to come in when a bolder policy may be adopted. My object then was in the first place to increase my bulk of manure and apply it in the manner that appeared to me most effective; as soon as my plants were matured I brought six single bullock cart loads of grass and weeds from the cinnamon field daily and put them into the cattle sheds. At

the end of three months there was about two feet deep of manure accumulated; the cattle were removed to another shed and the mass watered, if it appeared to dry, for the process of fermentation, and after lying for another month it was removed to the field—a single bullock, cart load laid in the centre between four trees, spread equally over the surface and dug in. In this way I now, with 80 head of cattle, manure one acre every week. The cattle are almost entirely fed on the coconut field, and the cost per acre including tendence of cattle, collecting and transporting litter, putting out the manure and digging the land, is as near as can be calculated 25s.

I am not prepared to assert that this is the very best manner of making and applying manure, but in the present state of my knowledge I know of nothing better. I wed my mind however to no theory; my own experience and hints from other sources may change my practice, but in the meantime I recommend it to others, such as it is, as a great advance on certain more slovenly and wasteful systems that are in common use.

It appears to me that spreading the manure and digging it in, is done on a sounder principle than that of placing it in a circular trench round each tree. The roots extend through all the soil, so that whenever manure is put they immediately come in contact with it and throw out fresh ramifications into it. Those fresh roots not only absorb the food furnished by the manure in the course of its decomposition, but they forage about in the surrounding soil and so imbibe soluble matters other than what has been put indirectly in the manure. If the manure is confined to a small space, there is no general stimulation of the roots; the grass is soon penetrated in all directions with fresh white pointed suckers, but they do not extend more than a few inches into the surrounding soil, while everywhere else the old roots have a dry inactive appearance. It is not improbable that the chemical action of manure on the soil with which it is brought into contact in some cases, renders some elements soluble that were not so before. Were it not so the same quantity and the quality of manure would produce an equal effect in all soils, but every one knows that this is not the case, but that effect is different with texture and composition in the soil. A light permeable soil, however poor in its original character, always gives a better return for any amount of manure put into it than a heavy compact one.

GERMINATION OF COCONUTS.

Coconut cultivators in Ceylon will be interested in the following accounts of experiments on the Madras Farm:—Attention having been recently directed, in several scientific journals, to the possibility of hastening the germination of hard husked seeds, by steeping them in solutions of different salts and acids, especially in solutions of sulphuric acid, an experiment was made to test whether the germination of coconuts could thus be hastened. For the experiment ten fresh coconuts were taken, and they were treated as follows:—

Experiment.

No. 1.—Two nuts, steeped in water.
,, 2.— ,, ,, with 5 P. C. of sulphuric acid.
,, 3.— ,, ,, with 10 P. C. of ,,
,, 4.— ,, ,, with 15 P. C. of ,,
,, 5.— ,, not steeped.

The nuts were kept in the water, and solutions, for five days. On the 1st of December last, the whole of the nuts were planted in a piece of suitable

soil. The soil was watered when necessary. On the 12th of March one of the nuts sent up a vigorous shoot, but the others having failed to send up shoots, they were all dug up on the 31st of March, when they were found in the condition stated below :—

Experiment.

No. 1.—Both nuts had germinated well, and produced vigorous shoots.
,, 2.—One nut had germinated, the other was rotten.
,, 3.—Neither of the nuts had germinated, but both were in good order.
,, 4.—One of the nuts was just commencing to germinate, both were in good order.
,, 5.—One of the nuts was just commencing to germinate, bothe were in good order.

As far as can be judged from this single experiment, steeping in acid solutions seems to retard rather than to facilitate the germination of coconuts, while steeping in pure water hastens germination. The subject will, however, receive further attention, and other experiments will be instituted.—*Tropical Agriculturist.*

BATTICALOA TAMIL LABOUR, &c.

To the Editor Ceylon "Times."

Sir,—In my letters dated November 22nd and November 26th, 1906, I gave the following figures as the cost of sundry works on my estate in Batticaloa :—

Picking or gathering per 1,000 nuts :

Season	1903–1904	... ...	44.55 cents per 1,000
,,	1904–1905	... ...	26·45 ,,

Making copra :

Season	1903–1904	... ...	43·82 cents per candy
,,	1904–1905	... ...	47·02 ,,

			per cooly.
Check-roll average for	September	...	21·86 cents
,, ,,	October	...	22·54 ,,

Cost of opening and filling in manure beds—R1·25 per 100.

To these figures I absolutely adhere, and I now have the pleasure to enclose the June accounts of the estate for your private information, from which you will be able to check the above items. I also beg to hand you the September and October accounts. The books of the estate and the check-roll are equally at your disposal in case you would wish to further verify the figures. From the September and October accounts the check-roll average may be worked out, and also the cost of making and covering the manure beds round the palms for artificial manure. I am inclined to think that the cost of this work is the same for cattle manure, as I believe equally large beds are cut in both cases. As it happens, green stuff *has* been applied with the artificial manure this year. I shall, however, have much pleasure in making certain as to size and cost of the beds used for artificial and cattle manure, and in forwarding you the figures if necessary.

In reply to Mr. Lienard's questions—

(1) I certainly do not include such extraordinary and wonderful items as "interest on the cost of elephants, stores, carts, repairs, depreciation, etc." in the figures given for picking or gathering. Our two elephants,

which are used for all transport work, in addition to the cartage of nuts from the field to the copra yard, have a separate item in the accounts to themselves.

(2) Women and children are rarely employed, and then only for watering supplies, or other light work.

(3) The cost of "picking" is for the coolies employed in "picking" or "gathering" the nuts. These coolies do *not* receive extra wages in the shape of coconuts.

Most of the work is now, I understand, done on contract.

For September 56½ coolies, costing R12·35 according to the usual check-roll average rating, picked 71,084 nuts. This is roughly equivalent to one cooly per 1,255 nuts, or *17·40 cents per 1,000 nuts!*

I should not judge that the thatching of the estate store would be a legitimate charge against "making copra," but one lives and learns.

It is owing to the cheapness of the cooly wage in the Batticaloa district, combined with the unusual intelligence and initiative of the Tamil and Moor inhabitants of the Eastern Province, that this side of the Island forms such an excellent recruiting ground for labour.

"The extensive irrigation works absorb a large amount of local labour," to quote Mr. Lienard. Moneragalla likewise is now largely indenting on the same supply, and, as in both cases higher wages are paid than are possible on the coconut estates of the districts, there is naturally a tendency for the latter to suffer, especially if they are situated away from the thickly-populated centres.

The rate of wages mentioned for Moneragalla is correct, but it is interesting to note that the Batticaloa Tamil, though he comes some 50 to 60 miles to Moneragalla, is paid the same rate for most contract works, such as holing, etc., as the Sinhalese resident in the district, in villages within a few miles of the estates.

The Batticaloa Tamil or Moor is acclimatised to the country, and as a consequence does not suffer from fever to any appreciable extent. He turns out regularly to work, is distinctly superior in intelligence to the ordinary Coast Tamil, and, like the Jaffna Tamil, may be called the "Chinaman" of Ceylon.

The coolies are now being employed at "tapping," and I am informed by a gentleman, who is certainly in the best passible position to judge, that in his opinion they will prove themselves "invaluable at this work." —I am, &c.,

HENRY M. ALLEYN.

DISEASES OF THE COCONUT PALM.

COCONUT LEAF DISCOLARATION (AND ALLEGED DISEASE) IN CEYLON.

KANDY, April, 20th, 1889.

I beg to report that I visited Veyangoda on the 27th March, spending part of the 27th and 28th inquiring into the subject of the 'disease' affecting the coconut palm. In certain areas in Veyangoda I observed that the trees were in a very backward condition—looking sickly and parched. I brought away with me leaves from affected fronds, and examined the discoloured portions of these leaves under the microscope at the School of Agriculture. [This instrument was neither complete in its fittings, nor powerful enough for the examination of minute fungi.] I was however, able to discover a parasitic fungus in the specimens I brought away with me.

I had hoped to be allowed sufficient time to carry on my enquiry into the subject more thoroughly than I have done, using what intervals of time I had to spare, and availing myself of extraneous aid offered me in the matter of getting at better microscopic appliances.

I have, however, been able to visit districts where coconuts are cultivated both far from, and near to, the coast, and to note the different modes of cultivation and treatment of the soil adopted in the various plantations; and I have no hesitation in saying that thorough cultivation is the surest way of combatting the evil. Where the trees have been helped to maintain their vigour the affection was at a minimum, and in places where I would have expected to see the trees badly affected, but whereas thorough cultivation as one would have expected to find in the best agricultural districts in England, was adopted, there was hardly any indication of the 'disease' to be noticed. In areas where the attack was at its worst the soil was generally not in a condition favourable to luxuriant growth. A favourable chemical condition of soil is correlative to a good mechanical condition produced by working, liming, draining, &c. Thorough, deep cultivation must be adopted in soils inclined at all to be heavy—even at the risk of temporary loss, followed by liming—and if necessary—manuring. Deep draining is especially necessary for heavy soils. No one who has seen these operations carried out under necessary conditions, and seen their results, can doubt their efficacy in preventing those conditions in the crops grown which favour attack from fungoid and insect pests.

Now in enquiring into the cause of a weakly growth, I would enquire first, whether good "seed," from a healthy and well-developed stock was used, whether the planting was properly done, and whether the crop has been well treated. It is difficult in the case of a perennial like the coconut, to get at the remote antecedents of the plant, but to anyone coming from a country where the art of agriculture is practised to perfection, the niggardly treatment of the soil, and especially coconut soil, in the generality, is most striking. Where the advantages of a fallow or a rotation are shut out, it behoves cultivators of coconuts to use every artificial means of maintaining the fertility of the soil. As exceptions, I have seen coconut estates under a very perfect system of cultivation, and as I mentioned before, they showed no indication of suffering from 'disease'—the plantations were, moreover, on a comparatively stiff soil, and at a

istance from the sea. I cannot agree that salt. and salt only, is necessary raise the affected coconut tree to a healthy state, but I do not mean to nderrate the value of salt in coconut cultivation; and I may here state hat a supply of salt under easier conditions, but with what precautions ay be thought proper to preclude it from being used for culinary urposes. is a great desideratum. But it must be remembered that the se of manures must follow cultivation of the soil; and in heavy soils. ithout thorough deep draining, the advantages of manuring are nullified. hen all these operations so necessary to a soil continually growing the me crop, must be regularly and systematically carried out, not in atch-work style. No experiment is required to prove their necessity. esults must be waited for; it will take time under the effects of previous l-treatment.

An outlay of capital is, of course, necessary, but the increased returns, nd the resultant vigour of the tree—enabling it to withstand attack, will ore than repay this outlay.

C. DRIEBERG.

SUPPLEMENTARY REPORT.

In sending out this Supplementary Report of the Coconut Leaf Disease uestion, I need not apologise for the delay in its appearance, for those ho understand the nature of such an enquiry will admit that it must be ased on close observation. and entail time sufficient for examination of aves and of soil, for watching phenomena as they occur in time. for bserving the effect of changes of climate and temperature, for enquiring to the history and progress of the plantations, and gathering a vast mount of information regarding various estates. I have spent much time this, but no more than was necessary to enable me to come to the onclusions I have arrived at. During the past nine months I have, rough the courtesy of estate proprietors and lessees, been enabled to sit a number of estates with the object of making observations, and of athering information which they were only too ready to give me. I take is opportunity of recording my gratitude for the help they afforded me this way.

But perhaps I owe an apology to many who will read this report for ntering too minutely into the chemical aspect of soil cultivation and ant-growth. Many are perfectly conversant with the facts.

Since my first report, however, questions in this connection have arisen the columns of the daily press, and discussions have been carried on agricultural chemical subjects, involving points that were scarcely fairly ated. I had neither the time nor the inclination to take part in these scussions, but at the same time, feeling it my duty to in some way help wards the clearing up of some of the points that have arisen, I take the portunity of expressing my views, in this report, for, as a matter of fact, e questions at issue, are closely connected with the subject of the proper ltivation of coconuts.

I have endeavoured to summarise the discussion as much as possible, d at the same time to note the weighty opinions of men who have had ng experience in coconut cultivation; and the conclusions I have arrived t are. as I hope to show, in accordance with the ideas of both practical d scientific men of repute.

Public attention was first drawn to coconut-leaf disease in Ceylon in letter from the Veyangoda correspondent to the "Examiner" in its issue the 31st January, 1889, when it was thus described: "It (the disease) first observable as orange-coloured spots on the leaves. No fungoid

growth is observable by the naked eye, only the discoloration of the leaf. As time wears on the orange-coloured spots dry up and are of the colour of withered leaves. Some fronds are so severely affected as to die off, and in these an ashy substance very like fungus is observable by the naked eye." Specimens of leaves with the disease were forwarded to Dr. Trimen, Director of the Peradeniya Gardens, who, after a cursory examination, gave it as his opinion that "their appearance suggests a failure of proper nutrition;" he would "look to the roots and the soil for the cause." "I cannot but think," said Dr. Trimen; "that these (plants) are being grown under some uncongenial conditions. . ." "one requires to know the history and surroundings of the plants themselves and watch their progress for some time." The Veyangoda correspondent writing of this opinion of Dr. Trimen makes the following statement:—"In support of the theory of innutrition there is the fact that the severely-affected plants are invariably the weakly ones; *per contra* all the weakly plants are not affected." The former statement is an important one, and the conclusions to be drawn from it are in no way affected by the latter. I hold, and I trust I shall make it clear further on, that it is the fact of a tree being insufficiently nourished that brings it under the influence of those agents, the effect of whose work is seen in coconut-leaf disease.

In an article on "Salt in coconut cultivation" published in the "Examiner" of February 21st, 1889, the theory put forward by the writer "B" is that trees are possibly suffering from the absence in the soil of salt, or from its presence in too small quantities. This I consider very improbable in an island of the extent of Ceylon, which moreover comes under the influence of monsoon winds. Again, there is the fact that a good many trees were affected and badly affected "by coconut-leaf disease" on the sea-borde. Quite lately the same writer made the statement that the application of salt to badly-attacked trees resulted in no beneficial effect, in fact that it aggravated the attack.

In the "Examiner" of the 22nd February, 1889, the Veyangoda correspondent gives the opinion of "perhaps the most intelligent and practical planter engaged in the cultivation of coconuts" to the effect that trees are suffering from an insect attack, that the juices of the trees are weakened and diseased by want of nutrition, and that inutrition is due to the hard and impervious nature of the soil at Veyangoda (where the attack is prevalent in its worst form). This opinion is, in the "Examiner" of March 5th, 1889, said to be that of Mr. William Jardine of Golua Pokuna estate, Kadirana.

Of the salt theory propounded by "B.," Dr. Trimen says:—"I scarcely think that the mal-nutrition of your trees—to which I attribute the dead spots in the leaves—is due to want of salt in the soil; unless indeed the land where they grow is quite abnormally wanting in this almost invariable constituent . . . I should rather look to the physical properties of the soil, and especially the drainage. That the mortified spots may be set going in the first instance by the punctures of a minute bug is by no means improbable. So far as I have seen, I am not disposed to consider these spots a very alarming phenomenon. They are pretty frequently to be seen on all palms if not in quite a healthy condition, and I quite expect that under a more liberal treatment they will cease to appear.

"W. J." recommended the following treatment to raise the conditions of the trees so as to cope with the disease:—"Stiff and clay lands should be broken and turned over in clods to a depth of fully eighteen inches by means of strong steel-bladed picks, afterwards treated with 30 or 40 bushels of freshly-slaked coral lime to the acre scattered broad-cast and allowed to be washed in by the rains. The clod would permit of free aëration, and all the rain would be absorbed and percolate through the soil, instead of as at present, more than one-half being lost owing to the impervious condition

f the soil." I cannot pass over this recommendation without a word of upport. The niggardly treatment which coconut land generally gets, as to he working up of the soil, cannot but tell disadvantageously on the crop. No amount of "trenching," as I have seen it done on some estates, will ompensate for this neglect. This thorough working up of the soil, while t has all the advantages of draining, at the same time facilitates the reparation of plant food. The soil will then be able to draw its moisture oth from above and below. The suitability of thorough drainage for oconut cultivation has been questioned.* It is against the principles of gricultural chemistry that a tree whose roots rest on a water-logged trata should thrive for long. The sickly appearance of trees growing nder such conditions is quite a common and familiar sight. It is absurd o point to a solitary apparent exception to this rule, and, clinging to it, ose sight of facts founded on laborious scientific research. This mode of rgument, characteristic of a warped judgment, is most unsatisfactory to neet. Water may be presented to the roots to any extent, but the necessary ondition is that it should not be stationary. On the sea-shore we ee the roots of the coconut palms continually bathed with water, but the exture of the soil is such as admits of its ready percolation. Thorough raining not only relieves a soil of excess of water, but paradoxical as it nay at first appear, it greatly mitigates the effects of dry weather; when oil is drenched with water, and dried by evaporation, it becomes hard, specially if it be of a clayey nature. Land that is dried by drainage absorptive and retentive of moisture dropped by dews and acquired from he atmosphere; while the soil deepened by drainage or deep cultivation ermits the crop to put forth stronger and healthier roots, and thus ecomes secured against drought. The most successful estates I have ooked over have received the treatment which secures such results. I bserve that within the last year the thorough working up of the soil being adopted more generally, but the benefits to the tree to be expected this case will have to be waited for. This mode of treatment must be onsidered a matter of routine at such intervals as may be thought dvisable.

It is no argument to say that because the necessity for such ultivation has apparently not been recognised hitherto therefore it annot be recognised now. In America, once on a time, corn grew and ave large yields year after year with little attention and care, but he time came when this manner of cultivation was no longer admissible, r whatever the crops cultivated, it is plain that continued cropping ithout proper cultivation and the use of manures must ultimately ring us to a time when the crops grown will no longer pay the he cost of cultivation.

As I mentioned in my first report, there is some considerable difficulty getting at the history of the various plantations, affected and unffected, but during the time that has elapsed since I wrote, I have een able to gather a good deal of information of this nature, in most ases from those who had a personal knowledge of the facts. I do not tend to mention the names of any estates or even indirectly indicate heir situation, for I do not consider it fair (being convinced of the redisposing causes of the disease) to make disclosures regarding the story of any private property in a public report. I am throughly satisfied my own mind that where I have seen the disease in its worst form, there as always an antecedent of bad treatment, whether from sheer neglect

* In the "Examiner" of Sept. 10th, 1889, the Veyangoda correspondnt says, that having occasion to drain deeply a bit of rich clayey nd on which coconuts did not make the growth that one can reasonably xpect of them, more especially as that particular patch had received ery generous treatment, he was surprised to find very little root growth, marked absence of feeding roots, and most of the roots rotted. This as an opportune bit of experience.

from motives of economy, from the use of bad seed-nuts and careless planting; or, on the other hand there were natural disadvantages. For while a soil can be made fertile by much mechanical labour and the addition of such substances as it is deficient in, if this cannot be done except at a cost as great as, or greater than, that for which fertile soils can be procured, the soil may be regarded as practically worthless. I have during my observations seen soils that illustrate all these conditions either singly or in combination.

The circumstance that the mechanical condition of the soil, where the trees show the attack, is favourable, is not sufficient for healthy growth. It may occcur that though the mechanical condition is not of the best, there may be present in the soil a sufficiency of soluble plant food for a certain period; but, on the other hand, though the mechanical condition may be of the most favourable nature, it is quite possible that most of the mineral constituents may be of the most insoluble kind, or of a perfectly useless nature—the necessary mineral ingredients of plant food being absent, such results depend on the origin and history of a soil—not only on its derivation from particular rocks, but its modification by the natural agents, chemical, mechanical, and animal. If it can be proved that the chemical condition of a soil is faulty, that it lacks or is deficient in one or more of the elements of plant food, while the growth on it is healthy and vigorous, then can it be said that the principles of agricultural chemistry are unsound; while the same conclusion may be reasonably come to, if while both the chemical and mechanical conditions of the soil are favourable, the growth is weakly and unhealthy—of course assuming that the selection and planting of seed nuts were well done.

The existence of isolated areas of unhealthy growth must be accounted for as being caused either by unfavourable chemical conditions, or by peculiarly uncongenial mechanical conditions of soil, possibly by an unsatisfactory substratum, or again by carelessness in selection or planting of seed nuts, or lastly, by neglect for any period, especially during the early stages of growth. As I have stated before, a tree which has up to a certain period appeared healthy and robust may begin to exhibit unhealthy symptoms from a deficiency of plant food, or moisture (possibly induced by a spell of prolonged drought—for water is necessary not only for the assimilation of food, but also for its elaboration and for the circulation of sap). This failure in very limited areas—more limited than in any coconut plantation—is often met with in cereal, root, vegetable and garden cultivation, and special treatment in various ways is necessary where the planting and seed are not at fault; such as improving the mechanical texture of the soil, adding either a material such as lime which liberates plant food, or some manurial substances. In certain cases a previous vegetable growth may account for the exhaustion of particular elements of plant food. It is on consideration of these causes of failure in cultivation that one is impressed with the need for caution in the selection of a property; and where one proprietor has had the opportunity of selecting his own seed-nuts, watching their growth in the nursery, superintending their planting out, helping their start in the field under the most favourable conditions, for care during the early stages life whether of the plant or animal is of primary importance for healthy development in after life—it is here that he has the advantage over another proprietor who takes over his estate ready planted. Hence the importance of a careful enquiry into the history of soil and crop to ensure a safe investment, especially in the case of trees of a perennial character. This is too much lost sight of. Often after-care and liberal treatment will improve the condition of trees, and this no doubt many have found by experience, can frequently be successfully done; but as before mentioned there is a limit, and if the effort at improvement entails

a cost that is not commensurate with the returns that may be expected, then such a property must be considered a failure. I have in view an extreme case of this nature of an estate most perfectly planted and liberally treated, which every attempt to improve without incurring financial loss, has signally failed.

There have been reports from abroad of coconut trees affected with disease. In an article by the Hon: B. Howell Jones, which appeared in the "Journal of the Royal Agricultural and Commercial Society of British Guiana," reference is made to the disease affecting coconut trees in Mahaicony, thus: "Here and there we saw signs of an inexplicable coconut disease, not to be confounded with the attack of the beetle, and on talking over the matter, both Mr. Smith and Mr. Mustard were of an opinion that it results from the planting of green nuts which grow much more rapidly than ripe ones, and that after bearing one or two crops they seem to get exhausted and die away." Mr. Quelch, curator of the Museum and Editor of the above-mentioned Journal, writes me that that the disease in British Guiana is evidently identical with that in Ceylon, and that it is now manifesting itself by a dropping of the half-ripe fruit and branches. I have observed this result in some parts of the Island where the attack is bad. The opinion recorded by the Hon. Howell Jones is worthy of consideration. The growth from an immature nut cannot be expected to be a healthy one; but whether the nut or the soil be at fault, it must be borne in mind that the disease is associated with an unhealthy growth. "The disease," says Mr. Quelch, "is common on the different parts of the Cocals. but it does not seem to spread to any alarming extent."

Mr. J. H, Hart. Superintendent of the Botanical Department. Trinidad, referring to the coconut palm disease in the West Indies, and distinguishing it from the attacks of beetles and scaly blight, says that traced to its primary source the disease would appear to be caused by a state af semi-starvation induced either by drought or a deficiency of manurial constituents in the soil of the particular district, and that where these causes do not obtain it disappears. In my own experience I found this to be the fact for during my visits about the middle of last year I found certain estates suffering from the effects of the prolonged drought which then prevailed, and showing much discoloration of leaf, but with the return of the rains and the measures taken to combat the evils arising from a lack of moisture, these effects have ceased to appear. On other estates, however, the disease does not show any signs of improvement, and in such cases I cannot but agree with Mr. Hart that the want of sufficient supply of plant food is the origin of the evil.

I am indebted to Dr, King, analyst to the City of Edinburgh and the leading Agricultural Chemist in Scotland, for help in the matter of soil analyses for which I had no appliances at the Colombo School of Agriculture. Mr. John Hunter of the Minto House Chemical Laboratory referring to the analysis of a mixed sample of soil and sub-soil from a part where the coconut trees are most affected with disease, says: "You will notice that the soil is *very* low in phosphoric acid, and low in potash; there is an abnormally high percentage of oxide of iron and alumina . . . . I may say that a soil recently analysed here contained more phosphoric acid than your sample does, and yet was incapable of raising a healthy crop." Here I consider we have a flood of light thrown on the subject. The well-known maxim of Playfair that "it is the body *in minimo* that rules the crop" instantly suggests itself in this connection. It may be that phosphoric acid and potash are present in the soil, but not in a condition available as plant food, and here it is that the importance of the operations which favour the liberation and distribution of soluble plant food comes in, for a soil may contain an abundance of phosphoric acid, potash and magnesia, and yet be infertile if these exist as apatite, felspar and serpentine. It is needless for me to cumber this report with suggestions

as to the best means of supplying phosphoric acid and potash to the soil in a manurial form; let me only remind owners of estates that they should use the most soluble manures containing these foods if they look for early results, and if they wish to come to the aid of their trees before long--as they should. I mention this becaue I know of cases where manures are being applied in a most insoluble and almost worthless condition.

But on the texture of the soil depends its powers of absorbing and retaining manures. Now the fact that there is an abnormally high percentage of oxide of iron would seem to indicate that more thorough draining and working up of the soil would tend to a better balancing of the proportions of plant food. I am aware that the soils in many parts of Ceylon have very large proportions of iron oxide, as analyses I have before me show; but in the case in point, this preponderance of iron exide is to be considered together with the abnormally low percentage of the most valuable mineral food ingredients of plants. Certain of the compounds of iron we know are noxious to vegetation, while "reverted phosphate" of iron, as such, deprives the land of more soluble phosphates which might otherwise be found.

Here I must support the recommendation quoted in the early part of this report, that lime should be applied to the soil of these infected areas, Not only will lime act mechanically and improve the texture of soil, which being made more porous is better aërated, but it supplies a base which forms soluble salts, and thus liberates plant food. If I remember aright, it has been reported in the newspapers that an experiment with a dressing of lime to affected trees did improve their condition.

Where the balance of nature has been disturbed, and one crop has been selected for a particular area to the exclusion of all others, contrary to the course of nature, it is but natural to expect that the soil must eventually fail its supply of certain ingredients of plant food, and this more especially where the soil is not of the most fertile character, when the same food ingredients which the crop most affects are continually being drawn upon. Even where in a state of nature one crop is confined to restricted areas, we know that there is such a thing as a natural course of rotation, and one crop gives way to another: this has been recorded in the case of natural forests of trees.

What is of great importance is that the feeding habits of cultivated plants and trees should be throughly understood from experience and the results of analysis, and that plants and trees should be so treated by cultivation and manuring as to ensure a sufficient supply of the food ingredients necessary for their healthy growth. Of course there are special circumstances, such as the occurrence of long droughts, which are practically beyond the control of cultivators, and these have to be dealt with as well as possible so as to mitigate their effects. I have examined some roots dug up from an infected area, which appear to have a tendency to die off, but have not been able to note the presence of any organism which can account for the result. It accounts for the withering tendency of the roots as the result of those causes which bring out the weakened condition of the tree, and especially a lack of sufficient moisture.

The term coconut leaf disease as used in Ceylon I consider incorrect in its application. It has been indiscriminately applied to every form of discoloration on the leaves, of whatever nature. Now there are some discolorations of a withered appearance resulting from the puncture and sucking of minute insects, and these are often seen in healthy trees, the discolored patches being distinct in outline surrounded by a healthy growth, while the trees are not in any way affected in health. Those, however, occurring on weakly trees are the nuclei from which decay spreads to such an extent as to seriously injure the health of the trees. Again,

here is the appearance of yellow discolorations either as spots or all hroughout the leaf resulting from a failure of the leaf to elaborate hlorophyll, and this cannot but be the result of innutrition (where the eaf is not with ring in its natural course). In weakly specimens I also ound the presence of a fungus presenting to the naked eye a turgid rown discoloration in the leaf tissue, but I am convinced that there is othing to cause any alarm in the occurrence of the fungus which from ts nature need not lead to suspicion of its spreading, or indiscriminately ttacking coconut palms.

There have been various means suggested for scaring away insect ests, whether fly, beetle or bug, which it is needless for me to repeat ere, but keeping the land clean is of primary importance in bringing bout this result. The unsatisfactory condition of the soil as shown by nalysis is a matter that must command the attention of those whose ninds are exercised about this so-called disease. Sir John Lawes, the reatest living authority on agricultural matters, says: I consider that lants are liable to be attacked by fungi, parasites, &c., in proportion as he soil is deficient in available mineral food. . . . The greater the mount of mineral matter at the disposal of the plant, the greater would be ts power of resistance."

I consider that there is no cause for alarm about the so-called Coconut Leaf Disease to those who are cultivating their lands after the most pproved methods. The idea that danger or destruction is threatened enerally by a fungoid attack must be put away. The consensus of pinion, and notably that based on analyses of soil, tends to prove that hose areas where the disease prevails to such an extent as to disquiet the ninds of proprietors and lessees, are suffering from an improverished conlition of the soil so far as the successful growth of coconuts is concerned: nd to cope with the disease the soil must be by every available means—which I have endeavoured to indicate—raised to the required standard of fertility.

C. Drieberg, B.A., F.H.A.S. F.R.S.E.,
Member of the Royal Agricultural
Society, England.

BUD ROT OF THE COCONUT PALM.

This disease has been known to exist in the West Indies* for the last hirty years, but its exact nature has only been determined since the American occupation of Cuba, when the fact that large numbers of palms vere in a dying condition was brought to the notice of the U.S.A. Department of Agriculture. It was estimated last year (1905) that at the present ate of spread of the disease the coconut industry of Cuba would be lestroyed in ten or fifteen years.

There are no records of its occurrence in Ceylon. The numerous ccounts of a coconut disease which attracted the attention of the Colony in 1889-1890 do not describe any symptoms resembling those bserved in Jamaica. These are, however, described exactly in a letter quoted in Ferguson's "All about Coconuts") from Travancore, and robably the same disease is indicated in correspondence from Portuguese East Africa in 1903 (Royal Botanic Garden file). It seems certain therefore that "bud rot" has existed for a long time in the Eastern Tropics, hough it has seldom caused widespread damage.

* A complete history of the disease in the West Indies has been published in the *West Indian Bulletin*, vol. VI., No. 3, pp. 307-321.

A case was brought to the notice of this Department early in 1906. The specimen submitted consisted of the upper part of the steam, capped by a dark brown, soft, foul-smelling mass which represented the "cabbage." Its close resemblance to the West Indian "bud rot" was very evident, and a visit to the affected locality confirmed the supposition that we had to deal with the same disease.

The affected property is a small isolated patch of 10 acres, carrying about 800 palms, of which about fifty are dead or dying. The trees attacked are three to four years old; those in bearing do not show any signs of the disease at present.

The first indication of the disease (in the case of young plants) is the withering of the youngest unfolded leaf. This turns brown and can be pulled out of its sheath: it is then found to end in a soft brown mass identical with that described above. The decay of this leaf is followed by the death of the other fronds in succession, commencing with the youngest and proceeding outwards and downwards. The fronds decay and fall off until only a conical stump remains. If the dying fronds are removed and the bud exposed, there will be found, instead of the white cabbage, a pale brown semi-liquid mass which becomes dark brown with age and possesses an odour resembling that of a tan yard. In an advanced stage this rot includes the whole of the cabbage, and stops only when the woody portion of the stem is reached. Only the soft parts are affected. The roots and stem are quite healthy but the destruction of the terminal bud necessarily causes the death of the tree.

The organisms responsible for this decay are bacteria which are found in abundance in the rotting tissues; they are short, thick rods with rounded ends which form whitish colonies of slow growth on sugar agar; a second form is described in the West Indian bud rot, but this has not been observed in Ceylon specimens. These bacteria appear to find an entrance to the cabbage along the youngest leaf; it is supposed that they develop at first in "the sweet slimy coating found on all the young protected organs" The affected trees in the present case are scattered throughout the plantation; this makes it probable that the bacteria may be conveyed from tree to tree by insects. The letter from Portuguese East Africa states: "If the dead tree is not immediately destroyed by fire the disease rapidly spreads to the neighbouring trees and finally throughtout the whole plantation."

The disease has not yet been observed on old trees in Ceylon. Its effect on these is described as follows:—"The youngest parts were those affected. The leaves and flowers in the bud were sometimes able, though affected, to withstand the disease so far as to open out, and some leaves and nuts attained almost their full development before the tree succumbed. In the case of tall trees, the first indication of the disease was the dropping of the young fruit." Another account states:—"The first outward indication that a palm is attacked is the falling of the young fruit; shortly afterwards the larger nuts drop, and the leaves assume a pale yellowish colour. Within a month all the larger lower leaves droop and fall, leaving the pale sickly tops, which at the first heavy wind blow over." The difference between the early symptoms on young and old trees is no doubt due to the fact that in the latter case the bacteria may enter the cabbage *viâ* the fruit stalks, The time required for the complete destruction of the tree is given as from one to three months.

The close planting which prevails on many native properties no doubt favours the spread of the disease by preventing the evaporation of moisture from the young shoots. In the present instance the young palms are shaded by older plants of the same species, in addition to a miniature jungle of cacao, areca, and jak.

The nature of the disease and mode of growth of palms make it npossible to find a remedy for trees already infected, and leaves for onsideration only the methods for preventing its spread. Diseased ees should be felled and the terminal bud burned. It should not be llowed to lie on the ground and become dry.

Disinfection of the bud by the use of a solution of copper sulphate lb. in 2 gallons of water) has been suggested, but, in order that this ay be effective, it would be necessary to ensure the complete satu-tion of every part of the decaying tissue with the copper sulphate. s this is impracticable, the method is not one that can be recommen-ed. A solution of copper sulphate (1 lb. in 20 gallons), or Bordeaux ixture, may be sprayed with advantage over the young parts of trees irrounding those attacked, in order to minimize the danger of infection.

The following instance is worthy of record, though the treatment oviously cannot be carried out except in special cases. On the firso opearance of the disease, *i.e.*, when the youngest leaf showed signs of ithering, the leaves were removed and the cabbage exposed. All seased tissue was then cut away. The tree has produced fresh leaves id is now quite healthy. It is obvious that this method depends for ccess on the discovery of the disease before it has penetrated to the owing point, and is only possible on young trees where the fection has taken place *viâ* the youngest leaf. When this method is ermissible, the knife should be sterilized before each cut when trimming e bud by dipping it in a five per cent. solution of carbolic acid. This ay be prepared by putting a tablespoonful in an ordinary whisky bottle, ling it almost to the top with water and shaking it.

It has been stated by some West Indian planters that a green inned variety of coconut is less liable to this disease than the reddish d yellowish kinds.

If steps are taken to remove dead and dying palms as soon as they e observed, there need be no fear that this disease will become a rious menace to coconut cultivation. Felling and burning diseased ees is no doubt an expensive process, but it must be remembered at the work is of the nature of an insurance effected on the remaining ees, and its cost should be estimated in terms of the survivors, instead being compared with the actual value of the trees destroyed.

The danger lies in the neglect of these precautions, because "it is ly a matter of one or two trees". The treatment of these "one or o" is of the utmost importance, and makes all the difference between trifling inconvenience and a serious epidemic.

T. PETCH,
Government Mycologist.

Peradeniya, March, 1906.

"COCONUT STEM DISEASE."

BLEEDING DISEASE OF COCONUTS.

PAPER READ BY MR. T. PETCH, GOVERNMENT MYCOLOGIST, BEFORE THE CEYLON AGRICULTURAL SOCIETY.

Until recently, the coconut palm has been considered practically free m fungus diseases. The open planting and sandy soil of the average conut plantation do not favour the growth of root or stem fungi. But h the extension of interest in coconut planting, and the better cultiva-n now adopted, it is found that serious diseases exist; and there is a dency to attribute these diseases to the newfangled methods. Now, it

is not to be supposed that these diseases have been recently created to annoy the planter who wishes to get a better return than was obtained previously. They have probably been in existence for a long time. but have not been thought serious. When the small cultivator, who owns 100 trees loses one per cent, he is not greatly troubled, because it is only one tree; but when the planter with 1.000 acres loses the same percentage, then the disease becomes prominent.

The disease, which is attracting attention at the present time, affect the stem of the coconut palm, usually at about six or eight feet from the ground. A brown liquid oozes out through the cracks in the cortex. and forms a rusty patch which usually turns black afterwards. On cutting into this patch, the internal tissues are found to be discoloured and decaying: they are brownish and finally turn black. If the diseased area is cut in wet weather, the liquid sometimes squirts out: in fact, it may in some stages, be collected in a glass by simply pressing on the diseased patch. After some time other black patches appear on the trunk, usually on the same side. When this happens, it will generally be found that this is not a new infection, but that the disease has worked up or down inside the stem, and the liquid has found a new outlet. I have seen trees which looked as though a bucket of tar had been poured down one side of the stem. It is important to note that there is no sign of the disease until the liquid oozes out, and that when this occurs the internal tissue is already decayed to some extent. What ultimately happens to the tree seems at present in dispute: I have seen dead trees which had been attacked by the disease, and the presumption is that this was the cause of death: the tree ceases to bear, the crown gradually becomes smaller, and the whole of the interior of the stem is reduced to a mass of humus.

The disease was first brought to the notice of the Department in 1903: we have the letter and specimen, but no further information. In 1905, a letter in the *Observer* called attention to the condition of some palms near the Negombo canal which were said to be attacked by beetles, and in 1906, the Katana Agricultural Society wrote to the Botanic Gardens on the same subject. They stated: The signs are:—

(1). Oozing out of the trunk a liquid of a rusty or dark colour.
(2). Followed by wounds on the trunk.
(3). In about two or three years the skin of the trunk drops out.
(4). The top portion of the tree gradually becomes thin.
(5). About the depth of three or four feet the roots wither—sometimes wholly, sometimes partly.
(6). The tree dies after 5 or 6 years, or in a shorter period.

I visited this plot on the canal bank near Hendala, and found that the affected trees were nearly dead. There was no sign of disease in the crown or the upper part of the stem, but the lower part of the stem was quite decayed internally, and when the outer layers were cut through, the axe when right through the trunk the other side. There was no open wound on the trunk. The decayed tissue resembled soil and it was impossible to find any fungus in it. The disease had advanced too far. Taking into account the stunted condition of the surrounding trees, it was considered probable that the decay was due to death of the roots through unsuitable conditions of soil. At the same time it was suggested that this conclusion should be tested by cutting out the diseased tissue on the first appearance of the liquid. If it was the stem disease this method might be expected to stop it, but if anything was wrong with the roots, the tree would die in spite of the treatment. As far as I know nothing was done. It has been stated in the papers that trees, which have been treated, have died, but no such occurrence has been brought to my notice, and it seems contrary to the experience of many planters. No one knew the age of these Hendala trees, but they looked about 20 years old.

The Katana Society in August, 1906, visited an estate at Nalla and reported their observations. The estate is about 330 acres, and between one and two thousand trees were said to be diseased. The late Mr. Jardine also inspected the same estate and informed me that the Superintendent had taken a census of affected trees and found that there were more than 3,000 and he believed that the disease was spreading. No trees had been killed outright, but it was plain to see that the trees were suffering, and bearing much curtailed. People in the neighbourhood stated that other estates were more or less affected and that on some a few trees had been killed and cut down. Mr. Jardine stated, "The disease begins with dark purple patches on the stems of the trees, which exude a dark brown fermented sap: on cutting into the stem it is found to have decayed, leaving only a bundle of discoloured fibres. The disease is not new to me, as about three years ago my attention was first drawn to it. The trees we saw at Nalla were some of them very badly affected, having patches close to each other over a large part of the stem, whereas those seen by me three years ago were but lightly affected. The plan I adopted was to clean cut out all the affected spots, burn them well with a torch of rags dipped in oil and then cover with hot coal tar. This effectually stopped any further advance. The progress of the disease is slow, taking possibly 4 to 5 years to kill the trees, but we think it is sufficiently serious to warrant attention." Later Mr. Jardine wrote: "The disease is pretty prevalent everywhere, but so far has not done serious mischief. It seems to have increased of late in certain localities. I can show you old trees where the disease has been at work for years, doing no more harm than destroying the bark—the hard wood below being evidently too dense for it to operate upon. On younger trees the disease penetrates right into the heart of the trees, and eventually leaves only a mass of dry fibres. The natives say it is the work of Taldiya, but what Taldiya is—they cannot tell.".

I visited this estate in company with Mr. Jardine, and obtained specimens of all stages. These show that there is a fungus in the diseased tissues. It appears to be altogether internal: the spores are formed in the decaying wood and are brought outside by the liquid which oozes out. This fungus is probably the cause of the disease, but the question is complicated by the presence of bacteria. I have made inoculations both with diseased tissue and the liquid, but these have not reproduced the disease. Here again there is a difficulty in obtaining a series of trees for inoculation. We have no young trees at Peradeniya; we obviously cannot follow the usual practice of growing plants specially for inoculation; and it is of no use to inoculate trees on a plantation where the disease already exists. But until we can produce the disease by inoculation, we cannot attain absolute certainty as to the cause. If the disease is caused either by fungi or bacteria, it can easily be conveyed from one tree to the next by the men who gather the nuts.

Nalla was visited in October, and an account of the disease was published in the *Tropical Agriculturist* for December. In July of this year, I received notice that further outbreak had occurred at Marawila: and at the same time, the newspapers learnt of the existence of the disease.

In response to a circular letter from Mr. Drieberg, the following information has been obtained:—The disease is known to occur at Veyangoda, Kurunegala, Mirigama, Henaratgoda, Negombo, Marawila and Nalla. It is said that it has not been seen at Batticaloa, nor at Ambalangoda. This is not correct for Ambalangoda, as I have seen trees affected there: in one case the tree had been diseased for about one year, and had already ceased to bear. I have also seen it in Dumbara. Three planters do not consider it important; six believe that it is likely to prove very serious, and these latter include every one who has seen badly attacked estates. Three say they have not seen it, though they live in districts where it is known to occur.

As to its effects on the tree, we have the following opinions:—(1) "It affects the tree so far as to cause the bark to decay and fall off." (2) "It does not affect the bearing of the tree; I never knew that it had killed the tree"!! (3) "Except for destroying the softer tissue of the stem and disfiguring it, I have not observed that the tree shows any falling off in bearing or health." (4) "So far as I have observed, younger trees are generally attacked, and seldom or never a very old tree." (5) "The tree is not less vigorous or less fruitful for the attack." Most of these opinions are from planters who have only seen a few diseased trees. It may be true,—indeed I believe it is true, that the disease does not seriously affect old trees, but it certainly does attack them. In one case where over 1,000 trees are attacked, they are about 60 years old. It may only affect the bearing of, and ultimately kill young trees, but we want more observations before we can assert that old trees are not killed. In any case, the old tree must be treated to get rid of the source of the disease.

The disease is not a new one. One planter has known it for thirty years, another for 60 years; and it has been known to occur in India for a long time. But that does not make it any less serious at the present time. In most diseases, it will be found that very little damage was done for a long period and that the disease was more or less neglected, until it suddenly beame so virulent that a whole industry was ruined, or enormous sums had to be expended in combating it. It is the usual course of a disease. Except in a few cases of introduced species, we have the fungi with us always, but it is only occasionally that they increase to such an extent as to cause an epidemic. It is generally admitted that the coconut stem disease is now spreading rapidly, after a long period of comparative harmlessness; and steps should at once be taken to stop it.

It is not possible to connect the disease with any local conditions. It occurs on swampy land, sandy soil, or rocky soil, either near the sea or inland. It attacks trees manured with artificial manure, or cattle manure, as well as those which have never received any manure whatever. It has been attributed to "infertile soil," "bad drainage," "over-manuring," "want of manure," "fermentation caused by the sun," "poor seed"; but none of these will apply to all the recorded occurrences.

The treatment has already been referred to. At the first appearance the diseased part should be cut out, the wound burnt with a torch, and then covered with hot coal tar. The pieces cut out must be burnt. When the disease has advanced so far that this local treatment is impossible, the tree must be cut down and burnt. This treatment is said to have been successful. It is now being applied to a large number of trees, and we may expect to hear more about its success or failure shortly. But in a large number of cases, nothing is done, and the conditions, under which many estates ars worked, prevent any treatment. It will, I think, be necessary to place this disease on the list of diseases under the Pest Ordinance in order to secure the proper treatment of all cases.

DISEASE OF COCONUT TREES IN TRAVANCORE.

Sir.—I shall feel thankful if any of your readers would, suggesting remedies, kindly explain for the benefit of us Travancorians, the following interesting yet disastrous phenomenon:—

Quite recently, in the central and northern districts of Travancore, we have lost several beautiful coconut trees from decay of the tender, unexpected leaf shoot. At first, the lower end of this shoot grows discoloured,

and, in a few days, general perfection of this and more or less of the cabbage ensues: and the shoots, in some cases, fall to the ground; the tree decays soon after, and we are left lookers-on and losers.

In trying to account for this remarkable disease, we are convinced that it cannot be the work of the Rhinoceros or Longi-corn beetle; for both these depredators bore into the shoot, cabbage or stem of the palm and, by early detection and careful tending, in the majority of cases, death can be stayed. Bnt in the case in hand, the only sign to us of the presence of the disease is the drooping on the tree of the leaf-shoot when obviously all our efforts to remedy the evil are ineffectual because too late. The explanation most generally accepted by the natives is that "falling stars" (meteorites, they say) have been at work, Another reason advanced has it that decay is brought about by an exuberance of sap, and that it can be remedied by bleeding the tree. This would at least appear to be plausible, from the fact that in our very moist climate evaporation is too slow to keep pace with the incessant ascent of water in the stem, and that it is only the moist vigorous trees that are, as a rule, affected; but the remedy is desperate. By a third cause given, the malady is attributed to the attacks of fungi.

With all these explanations, however, the fact remains that we are losing many of our valuable trees without making any attempt, so far as I know, to, if possible, prevent it. The hot weather has been unusually severe with us this year, and the monsoon rains unprecedentedly scanty; but I am not at all certain whether these facts are of themselves sufficient to explain away the very unsatisfactory state of affairs now obtaining in our coconut gardens.—A. M. SAWYER.—*Indian Forester.*

DISEASES OF THE COCONUT PALM.

It is more or less axiomatic that the number of diseases to which a given plant is subject, and the virulence of such diseases if no special precautionary measures are taken, increase with the spread of its cultivation. It is rather surprising therefore to find from manuals and essays on coconut planting that there is apparently no disease of the coconut palm worthy of mention. This relative immunity is not confined to Ceylon, but, to judge from their pulications, is shared by all other coconut growing countries. Insect pests are well known and their treatment occupies a large part of the literature of the subject. Can it be that every disease has been attributed to "beetle," or is it that the climate of the coconut districts and the methods of planting really discourage the attacks of fungi? I think it may be assumed that the latter to a great extent are inimical to fungi in general. There have been alarming reports of coconut diseases in the past, *e.g.*, of leaf disease in Ceylon in 1889; but no very serious damage has been done, and the disease—or the fear of it—has passed away, and left no trace, not even a scientific record, nor a specimen by which it could be identified if it occurred again!

During the visitation referred to, it was generally stated that the particular disease was one which had been prevalent, but not serious, for a long time. Without a knowledge of fungi and a microscope such a statement in the case of a leaf disease could be only a mere guess. But I have now to record a disease, apparently of fungus origin, which really has existed for a long time, but which has only recently caused any serious injury or loss of trees.

This was first brought to the notice of the Department in 1903, but no information was left on record. Last year, a correspondent of the *Ceylon Observer* called attention to the condition of some of the palms near the

Negombo Canal, and stated that "dead and dying palms were seen from the boat, between the second and fourth milestone on the canal. Sap was exuding from what appeared to be punctures on the stem made by an insect." In the early part of this year information to the same effect reached Peradeniya from several sources, and this particular locality was visited.

The affected trees are on a small island bounded by the canal and ditches, about a foot above the water level in the dry weather. The surrounding marsh is planted up in coconuts; these are remarkably stunted, so much so, that they resemble cycads. The diseased trees were covered to a height of seven or eight feet with black patches, caused by exudation of sap from minute cracks in the outer tissue. The upper portion of the stem was usually unaffected. The tissue immediately beneath the crack becomes discoloured, generally brown at first and finally black, and this condition spreads internally until the patches from adjacent cracks coalesce. The whole of the interior of the trunk is ultimately reduced to a mass of humus mixed with fragments of the harder fibres. In advanced stages the tree bears only a few small fronds, but the "cabbage" is not diseased. The bud remains sound so long as a section of the stem shows a region of undecayed tissue. Several trees were dug up and it was found that in general the roots were dead on the side affected; and as the material, both root and stem, brought away for microscopic examination did not show any fungus hyphæ, it was thought possible that the death of the trees was primarily due to the decay of the roots owing to the unsuitable situation. It was quite certain that the beetle observed only bored into the stem after it was dead. In order to test this conclusion, the treatment which is detailed below was advised, but as far as I could judge when I passed the place some months afterwards nothing has been done.

Quite recently one of our leading coconut planters (who had raised the question of this disease in 1903) kindly offered to show me other localities in which the disease existed, and under his guidance more valuable information was obtained. In a plantation at Nalla, which was visited, two thousand trees are said to be affected, and though none have yet died, the number of diseased trees is increasing. It was seen that the ideas founded on the observations made previously on the palms near the canal would not hold good there, but fortunately a clue to the origin of the disease has been found in the specimens there collected. The longitudinal cracks in the outer tissue are a more or less normal feature of the coconut stem. They are not necessarily connected with disease, though it is probable that fungus enters through them. In the earliest stages of the disease, the sap oozes out from the trunk and causes a brown or black stain on the exterior. If the diseased region is cut into during wet weather a quantity of sap runs out. The tissue beneath the black patch decays, finally becoming dark brown or black. Instances of this appear to be fairly common. There are numbers of old trees on which the disease has been at work for years, doing no more harm than locally destroying the outer tissues, the hard wood below being apparently too dense for it to operate upon. A hole, filled at first with dry fibres, is left in the stem.

But in the cases which have attracted attention recently, the first black or rusty patch is followed by others, usually on the same side of the tree, and the diseased regions extend internally until the whole trunk is merely a shell enclosing a brown or black soil-like mass.

There is no doubt that the progress depends on the character of the tree, and older trees appear to be less affected. But trees of all ages are attacked and the difference appears to depend on age only in so far as the older tree possesses a well-developed region of dense "wood." The trees which are killed succumb in from four to six years.

The fungus which is supposed to be the cause of the disease is wholly nternal. Its spores are formed in the decaying tissue and are brought to he exterior by the exuding sap. In order to have the disease under bservation, inoculations were made at Peradeniya with diseased tissue, and vith the sap containing the spores and some bacteria. But the only trees vailable at Peradeniya are extremely old, and it is as yet doubtful whether he infection has been successful. It is only by making pure cultivations f the fungus and inoculating the trees from them that certainty can be rrived at.

In addition to the Hendala and Nalla districts, I have seen odd trees ffected in the neighbourhood of Kandy. The "disease is fairly prevalent verywhere, but so far has not done any serious mischief. It seems to have ncreased of late in certain localities." "The progress of the disease is low, taking possibly four to five years to kill the trees, but we think it s sufficiently serious to warrant attention." These are the opinions of ur leading coconut planters.

The following measures were tried several years ago and have proved iccessful. All the diseased tissues were cut out and burnt, the wounds ere then burned with a torch of rags dipped in oil, and then covered with ot coal tar. All dead coconut trees should be burned. With respect to ie last point, the advice recently issued by the American Department of griculture in the Philippines may be quoted. "The first thing to do in oming into possession of a coconut grove, or in planting a new one, is to oroughly clean the ground. All manure heaps, rubbish, rotting or fallen ees should be removed and destroyed at once. Rubbish heaps and ecayed trunks if fallen should be burned." Now that America has taken hand in tropical agriculture, we may confidently expect that coconut iseases will receive full attention; they have been the first to recognise iat such work in the Tropics requires an equipment, if possible, better ian they have in America.

In the article on coconuts in Watt's Dictionary of the Economic roducts of India there is a reference to a stem disease which may be e same as the one we are at present concerned with; the information, owever, is not very definite, and the suggested remedy does not invite commendation. "Palms suffer from the attacks of an insect named *ionga*, which gnaws the roots of the tree. When a palm is suffering om the attacks of *Bhonga*, a dark red juice oozes from the trunk. hen this is noticed, a hole three inches square is cut in the trunk from ur to six feet above where the juice is coming out, and is filled with lt, which kills or drives away the insect." The recorder does not ggest how the salt reaches the supposed insect! The Sinhalese say at the disease is the work of "Taldiya" but what "Taldiya" is they nnot tell.

The other diseases of the coconut palm in Ceylon do not call for much tention. The "Bud Rot" described in Circular 15 has not been recorded om any other locality. A leaf fungus, *Pestalozzia palmarum*, is ex- emely common in the low country, but as it never kills a tree it is sregarded. Up country it seems to be much less common. As its me indicates, it is a relation of the "Gray Blight" of tea; indeed, if e lables were removed from mounted spores of the two species (and ere is practically nothing but spores to lay hold of in a *Pestalozzia*), one will be able to relabel them with any degree of certainty, Most conut diseases have been attributed to the effect of *Pestalozzia palm- um*, probably because all palm fronds bear that fungus, and it therefore curred on the supposed specimens of any disease which have been sent Europe. In Ceylon, it is confined to small spots on the leaves, and ough it must to some extent retard the growth of the tree, it does t cause diseases of the bud or stem. The West Indian Bud Rot is still ted by some to be caused by it.

A recent report from Java by Dr. Charles Bernard states that serious damage has been wrought by *Pestalozzia* in the case of young trees. In a plantation containing 5,000 plants, a year old, every tree was affected, more than half were so badly affected that there was no hope of saving them, and about 1,000 had died. Spraying with Bordeaux mixture is recommended, and is practicable in the case of young palms. Assuming that the cause of the disease is correctly determined, this offers a striking illustration of the possible differences in the effects of the same fungus on the same host in different countries :—T. PETCH—*Tropical Agriculturist.*

COCONUT DISEASES.

"Bud rot," apparently identical with the West Indian disease, appeared in a small native estate early in the year. The place was visited, and the diseased trees were cut out. All were young trees. The disease did not attack the older trees, and it has apparently not spread further. A circular and a leaflet in the vernacular on this subject were issued.

During tours in the low-country a leaf disease due to *Pestalozzia Palmarum*, Cke. was seen to be very common, more so than in the Kandy District. This has been known for a considerable time, but it is not regarded as serious. In Java it is said to have killed off hundreds of year-old coconut palms. It appears to be common on most palms in Ceylon; in the Botanic Gardens it occurs on *Licuala*, sp., *Pinanga Kuklii, Chrysalidocarpus lutescens*. Wendl., and apparently on others, which however have not been examined microscopically. It was intended to carry out investigations to determine whether this species is really distinct from the "Grey Blight" of tea, but these had to be postponed.

Attention was directed by the Katana Local Society to the prevalence of a stem disease of the coconut palm in the Hendala district, and later the same disease was investigated at Nalle at the request of our leading coconut planters. The disease is characterized by a flow from minute cracks in the stem of a liquid, which forms rusty brown or black patches on the exterior. In many cases, especially on old trees, it causes merely a local injury, but on younger trees it may reduce the whole of the interior of the tree to a brown mass of humus. The symptoms have been known for many years, but it is only recently that it has shown signs of becoming a serious disease. It usually takes four or five years to kill a tree. An account of the disease and a remedy which has been found practicable was published in the "Tropical Agriculturist" for December.

It may be pointed out that the question of "absentee" proprietors raises serious difficulties when diseases obtain a footing on coconut estates, as the conditions under which the estate is worked often preclude altogether any possibility of treatment.—*Peradeniya Royal Botanic Gardens Annual Report*, 1906.

COCONUT STEM DISEASE.

(*To the Editor "Ceylon Observer."*)

Peradeniya, Sept. 17th.

Sir,—May I make use of your columns to ask for information with regard to the coconut stem disease? At present, I am able to examine large numbers of diseased trees, but no dead ones. Apparently, I have already seen the only dead trees, viz., those along the Negombo canal.

should be extremely indebted to any of your readers who could inform e where there are any dead coconut trees, which exhibit the black atches characteristic of the "bleeding disease." In the *Observer* of July)th, it was stated that trees had been treated with tar, but "this has ot saved the tree." Where? This is just what we are wanting to know.

I am shown diseased trees, but no one is able to give an approximate iswer to the question, "how long has this particular tree shown signs being affected?" In some cases, the rot extends in apparently vigoris trees (manured) almost to the cabbage: in others the tree is completely illowed out and obtains its water supply through an outer cylinder only ie inch thick. If the disease travels through this cylinder, or if it aches the cabbage, it would seem that the tree must die. But this iould be a matter of fact, not of opinion or prophecy; and in view of ie declaration that the disease has been known for 50 years, the facts ight to be immediately available. At present our "laboratory knowdge" is a long way ahead of planting experience.

The fungus in the diseased tissues has now been determined. It companies the decay throughout, though from its peculiar character othing but spores can be found in old decayed tissue. It is *Thielaviopsis haceticus*. In view of this fact it is scarcely necessary to seek further r a cause, for this fungus is the cause of the "pine-apple disease" of gar-cane in Java, while the sugar-cane disease of the West Indies has een determined by Massee and Howard as another stage of the same ngus. Its effect on the interior of the sugar-cane resembles that in e coconut, but apparently "bleeding" does not occur in the former. ie disease obtains its name, not because it attacks pine-apples, but cause the interior of the decayed cane has a strong odour of pineoples. This is due to the production of Ethyl acetate by the fungus. have not noticed this odour in coconut stems in the field, but it is rticularly well developed when the fungus grows copiously in my culre dishes in the laboratory.

Reinfection with the fungus is, of course, the only scientifically curate proof that it is the cause of the disease; but there is practically doubt.

It has been suggested that the Indian Department of Agriculture ould be consulted in this matter. Dr. Butler, the Imperial Mycologist, rites that the diseases of the coconut palm in Southern India have not een investigated, but he is now visiting Travancore, etc., and may eet with this "bleeding disease."

T. PETCH.

DISEASED COCONUT PALMS.

A disease, the cause of which is not stated, is doing some damage to e coconut trees in Jamaica. The following description of the disease taken from the Jamaica *Gleaner* for January 12, 1903:—The heart leaves op out and the leaves, which are usually upright, fall down. When a e in this condition is cut down, the heart is found to be one mass of d-smelling, decaying vegetation, while the root and trunk are in perfect ndition. The disease often attacks the flower spikes with the result that any of the coconuts drop off while still young. This is frequently prelimary to the disease getting to the heart leaves, after which nothing can ve the tree. In the *Journal of the New York Botanical Garden*, Vol. IV, ges 4-7, Mr. F. S. Earle gives an account of his recent visit to Jamaica. e examined coconut trees suffering from what is apparently the disease that described above. Mr. Earle attributes the disease to bacterium. e points out the necessity for the prompt cutting and burning of all

infected trees, and says that 'it is claimed by some planters that a certain green skinned variety of coconut is less liable to this disease than the reddish and yellowish kinds.' If this is confirmed there is a possibility of raising a resistant race of coconuts. A disease, similar in many symptoms, is the subject of a paper in *Bulletin No 38, New Series Division of Vegetable Pathology and Physiology* of the United States Department of Agriculture. The disease appeared among the coconut palms in the province of Santiago, Cuba. The first indications of trouble was the falling of the young fruit. Shortly after the larger nuts dropped and the leaves assumed a yellowish colour. Within a month all the large lower leaves droop and fall, leaving only the pale, sickly tops which blow over at the first heavy wind. Here also from the root to within a few inches of the top, the trunk was found to be perfectly sound. Perforating the entire upper part of the trunk for 2 to 12 inches downwards was found the mycelium of a fungus, the fruiting bodies of which appeared as small white spots on the underside of the leaves. These might easily be mistaken for the scale insects (*Aspidiotus*) often found there. The fungus was identified as *Pestalozzia Palmarum*. On breaking open the lower leaves and cutting the centre of the green growing part open, the heart is found to be one putrid, offensive-smelling mass. It was found that the best way of preventing the spread of the disease was cutting down and burning the diseased palms. It is not necessary to burn the entire trunk, but only the top, with a couple of feet of the upper end of the trunk. In order that this preventive measure may have its greatest effect, it is absolutely necessary that united action should be taken. It would obviously be futile for the proprietors of one estate to eradicate the disease within its limits, if the owners of neighbouring estates omit the precautions and allow the disease to multiply and send its spores abroad to the others. These two diseases are so similar in their symptoms that it would seem not improbable that they are really one and the same. This however, cannot be definitely settled until something more is known of the cause of the disease in Jamaica. We trust fuller information will be obtained as the result of the work which we understand Mr. F. S. Earle has in hand at the New York Botanical Garden, and of the field experiments of Mr. W. Cradwick of the Department of Agriculture, Jamaica.—*Agricultural News*, Feb. 28.

THE BUD ROT OF THE COCONUT PALM IN THE WEST INDIES.

By Dr. Edwin Smith, U. S. Department of Agriculture.

General attention was first called to this disease by the reports of army officers during the American occupation of Cuba. The coconut palms were said to be dying in large numbers of some mysterious disease which should be investigated. Mr. Busck was sent by the U. S. Department of Agriculture to Eastern Cuba, and subsequently reported on the entomological aspects of the disease. Later Mr. F. S. Earle reported the occurence of a bacterial bud rot of the coconut in Jamaica. The writer has since heard of its occurrence on the mainland in Central America, so that it may be assumed to occur all round the Carribbean. It was studied by the writer at Baracoa, Mata and Yumuri in Eastern Cuba April, 1904.

The disease has made decided advances since it was studied by Mr. Busck in 1901, especially at Mata, and if it continues to spread as it has done during the past ten years ,it will inevitably destroy the coconut industry of the island, and that, too within the next ten or fifteen years. Already many of the planters are discouraged and not setting any more trees, since it now attacks trees of all ages, including quite young ones and those on the

hills as well as those close to the sea. The disease is frequently known as 'the fever,' and often one sees where the bases of the trunks have been scorched with an idea of preventing the development of the disease. The disease is not lodged in the roots, however, nor in the stem. These in all cases appear to be sound. The general symptoms are the yellowing and fall of the outer leaves, the shedding of the nuts, and some months later the death of the whole crown. The cause of this decline is not apparent until the tree is felled and the crown of leaves removed, including the wrapping of the strong terminal bud. The latteri s then found to be the seat of the disease. This bud with its wrappings of young and tender leaves is found to be involved in the vilest sort of a bacterial soft rot, not unlike that of a decaying cabbage or potato, but smelling much worse, the stench resembling that of a slaughter house. This rot, invisible until the numerous outer leaf-base wrappings are removed, often involves a diameter of several inches of soft tissues and a length of three or four feet, including flower buds and the whole of some of the soft fleshy white undeveloped leaves covering the bud and forming the so-called 'cabbage' of the palm. The rot stops very promptly with the harder tissues of the palm stem immediately under the bud and does not attack any of the developed leaves. It is a disease of the undeveloped tissues. When the tree is felled and opened up, carrion flies and vultures are promptly attracted bv the horrible smell. Fly larvæ and various fungi were found in the parts most exposed to the air and longest diseased, but the advancing margin of the decay was occupied only by bacteria, of which there appeared to be several sorts. No yellow or green florescent bacteria were obtained from the rotting tissues. All were white organisms of the 'soft-rot' type, mostly plump short rods with rounded ends, but occasionally longer rods, all apparently gas producers. One of the commonest sorts formed round dense creamy-white opalescent colonies on agar. Another formed thin gray-white iridescent colonies on agar. A terminal spore bearing tetanus-like organism was also often abundant in the decayed tissues, even close to the advancing margin of the rot, and this is probably an anaërobe as it was not obtained in any of the many cultures.

The picture of one diseased tree will answer for many. No fungi or insect injuries were found which could in the least account for the death of the tree. The disease is the result of a bacterial rot of the terminal bud and its wrappings. including the flower buds. The bacteria probably find their entrance through wounds of some sort, and their distribution is undoubtedly favoured by carrion creatures. The larva found deepest down in the rotting tissues was that of the common scavenger fly *Hermetia illucens* L. Occasionally the crown of a tree was found yellow from other causes, but if the youngest visible leaf (projecting five or six feet) was observed to be lopped over and wilting or shrivelled, the soft rot was sure to be found on cutting down the tree and removing the close-wrapped leaf bases. No attempt has yet been made to produce the disease by pure cultures. Diseased trees should be felled and the terminal bud burned or properly disinfected with sulphate of copper. Only the most energetic action is likely to avail.—*Bulletin of the Deparlment of Agriculture, Jamaica*, June, 1905.

DISEASES OF COCONUTS IN JAMAICA.

Considerable attention has been paid in Jamaica to disease of the coconut palm, many trees having been lost from one cause or another. Investigation by officers of the Department of Agiculture has shown that, while the immediate cause of death has been some insect or fugoid pest, the trees have been rendered liable to such attacks by unfavourable external conditions such as when trees have been planted in very poor stiff clay soils, when the soil has been too dry or saturated with standing water.

It has also been proved, however, that there is a specific disease "which attacks the flower parts and young nuts, sometimes spreading along the softer tissue, and at length reaching the terminal bud or the feeding roots."

Experiments during the last two years have 'shown the most effectual remedy is to spray with Bordeaux mixture at intervals of six to nine months until there is no trace of the disease.' With a spray pump and a long hose, the nozzle of which is carried up the tree by s boy, there is no difficulty in spraying even trees.—*Agricultural News*, April, 1905.

REPORT ON THE COCONUT DISEASE AT MONTEGO BAY.

Botanical Department, Gordon Town P. O., 24th July, 1891.

Sir,—I have the honour to report that I have visited Montego Bay to examine into the death on a large scale of Coconut Palms in that neighbourhood.

Several trees were cut down, and the roots, stem leaves, and cabbage examined. There was no evidence whatever of attacks by a beetle, there were some small larvæ, some wood lice, earwigs, ants of several species and other insects on the affected parts, but they were evidently only preying on the diseased juices, and were not the cause of the disease.

The roots were quite sound and the stem appeared to be unaffected. Both stem and leaves were of normal size, and there was no indication of a gradual dwindling of vitality due to lack of proper nourishment extending over a long period. The disease, whatever it might be, seemed to be quick in destruction.

The youngest parts were those affected. The leaves and flowers in the bud were sometimes able, though affected, to withstand the disease so far as to open out, and some leaves and nuts attained almost their full development before the tree succumbed. In the case of tall trees, the first indication of the disease was the dropping of the young fruit. It was stated that the disease in this condition had been checked by setting fire to the fibrous material at the base of the leaves, which process burnt all the leaves; new fronds, however, developed, and the tree was at any rate for the time saved. The application of salt to the cabbage had also, it was alleged, been successful.

If the terminal bud in the cabbages is affected, the tree is doomed. In almost all the trees examined, the sour smell of a putrefative fermentation was very noticeable, and I am of the opinion the disease is due to an organised ferment which is able to attack the very tender tissues of the youngest parts, even outside the terminal bud. If this ferment can be destroyed by fire or other means before it reaches the terminal bud in the heart of the cabbage, the tree may be saved.

Any remedy should therefore be applied on the very first signs of disease. If delayed too long until the terminal bud is diseased, the tree cannot be saved.

Although to fire the fibre at the base of the leaves is easy of application, it is not safe near buildings, and by the destruction of the leaves, the production of fruit is for a long time retarded with consequent loss.

I would recommend that those who do not care to apply fire should drench the cabbage with solution of sulphate of iron in water in the proportion of two pounds of sulphate to one gallon of water. A solution of sulphate of copper might also be tried in the proportion of 5 parts to 100 of water and a solution of boracic acid in the proportion of 4 parts to 100 of water.

All diseased trees which cannot be saved, should be cut down and burnt, o prevent infection.

In order to give the tree every chance of recovery the soil might be scraped away from the roots and the ashes of the burnt trees applied ogether with some manure.

It may be said that these remedial experiments are costly, but on the other hand the annual value of each tree is stated to be at least four hillings.—I have, &c., (Signed) W. FAWCETT, Director of Public Gardens and Plantations.

The Hon'ble the Colonial Secretary.

THE GODAVARI PALM DISEASE.

In continuation of former notices respecting this disease of Palmyra nd Coconut palms, a report has recently been issued by the Madras overnment, enumerating the results of the operations authorised by hem for the eradication of the disease, and the alterations which are to e made in order to ensure more effective work.

Three parties were set to work in widely separated districts, each onsisting of twenty toddy drawers and coolies hired on the spot in charge f a Revenue Inspector. As a preliminary, a return of the number of ead trees in each village was called for, and these trees were marked ith lime. "When the Revenue Officer in charge arrives to commence perations, a fresh count is made and fresh marks made, the second count nvariably giving higher figures than the first. Then the necessary toddy rawers being hired, those required to cut trees are provided with small xes, and those required for applying Bordeaux mixture are given small ots of the mixture prepared the evening before by the Revenue Inspector, hich, with a small bunch of rags for brushing it on, they hang to the backs f their belts. They quickly become expert at the work, and one man can ut off the tops of fifteen trees or treat some thirty-five in a day. The cut ops are collected and burnt every few days. Difficulty is experienced getting men to climb very old and thin trees, and these should be cut t the ground level. Ordinarily, however, cutting at the ground level ppears too slow and difficult to be employed. The diseased trees are rst cut. Then all neighbouring trees (usually for a radius of about 25 ards round each tree) are treated with Bordeaux mixture. Each tree equires about 1 lb of the mixture, and the cost works out at less than one ie per tree, but could be reduced by importing the Copper Sulphate equired from Calcutta, at about Rs. 20 f o.b."

The cost of two months' working in three firkas, *i.e.*, wages of oolies, fuel for burning tops, compensation for trees, and cost of ordeaux mixture, but excluding the cost of supervision, was Rs. 1,409. n Coringa firka 12,000 diseased tree tops were cut off and burned, and bout 15,000 trees treated with Bordeaux mixture, at a cost of Rs. 900. o claims for compensation have been made. In many cases the leaves

of the palms can be used for fuel, and thus the cost of fuel has been less than the estimate. The toddy drawers receive As. 4 per day.

It is proposed to alter the methods of working and concentrate all operations in one district. The selected district, Amalapuram taluk, is five hundred square miles in area. Eight working parties are to be formed and provision is made for a year's continuous work with an expenditure of Rs. 26,600. It is expected that at the end of three or four months most of the parties will be free to carry on operations elsewhere, one or two being kept to deal with the diseased palms which may be overlooked on the first round. Treatment of the surrounding healthy trees with Bordeaux mixture is to be given up for the following reasons. "The burning of diseased tops, thoroughly carried out, will in itself be sufficient to check the disease. Second, the concentration of all the workers on cutting operations will enable a much larger area to be deprived of its infective matter in a given time, and so reduce the danger of reinfection. Third and most important, the treatment with Bordeaux mixture appears to have appealed much more to the imagination of the ryots than the burning of diseased tops on account of their natural antipathy to destroying anything that may be conceivably of the least use to them afterwards."—T. P.:—*Tropical Agriculturist.*

"PYTHIUM PALMIVORUM": A BUD-ROT DISEASE OF PALMS.

As far back as 1898 a disease, similar in its effects to the destructive "bud-rot" disease of coconut palms in the West Indies, was known in Southern India as attacking the Palmyra palm (*Borassus flabelliformis*, L.) There was no reference to the disease in official papers until September, 1904; and in 1905, when it threatened to cause serious damage by spreading to the coconut palms, special attention was drawn to it. It was first noticed on an island in the Godavari district; from where it spread, until in August, 1905 it was calculated to cover an area of roughly 900 square miles. The progress of the disease, geographically, is slow but continuous; it was noted during 19 months to have spread some 3 miles. It has now gained a certain footing in some districts of Southern India and shows every indication of killing out all the palmyras in any locality.

The most serious aspect of the case is that it has been conclusively proved that the disease is communicable to the coconut palm, to which it is very destructive; and the spread of an epidemic disease among coconut plantations would be exceedingly serious, this industry being so very extensive in Southern India, Ceylon, Malaya etc. This palmyra disease is possibly indentical with the "bud-rot" of the coconut in the West Indies, which now threatens the entire destruction of the coconut industry in Cuba.

DISEASE DUE TO A FUNGUS.

The disease has been the subject of careful investigation by Dr. E. J. Butler, Imperial Mycologist of the Agricultural Department of India, whose special report to the Madras Government has recently been published. In this report Dr. Butler says, the parasite which is responsible for the disease is a fungus (*Pythium palmivorum*, Butl.), which gains entrance through the leaf-sheaths which closely encircle the green top of the stem below the point where the expanded leaves open out into the spreading head. Its principal characters of importance—from the point of view of treatment— are that it only emerges from the tissues of the leaf sheaths.

to form spores in the inner layers of sheaths, and that hence in the early stages before the dead stalk drops off, it is not exposed to conveyance by the wind. Furthermore, on account probably of the surgary nature of the palm sap, its track is rapidly followed by hosts of putrefying organisms which not only lead to the putrid heart-rot of dead trees, but also rapidly destroy by "poisoning" the parasite itself with the probable exception of its durable spores.

THE SPORES OF THE PARASITE

are of two kinds; a temporary form suited for very rapid propagation limited in time and space and quite ephemeral, and a lasting or durable form whose structure shows it to be well capable of withstanding adverse circumstances and probably of living many months.

The full history of the latter is not yet known but it is the probable agent of *extensive* as opposed to *intensive* infection. It is possibly capable of surviving even the putrefaction of the bud which the rest of the fungus cannot do, and after exposure by complete rotting of the "cabbage," may be conveyed to fresh trees and secure their infection. Water is necessary for the germination of the spores, but rain drops or the film of dew in cold weather is sufficient. Cases of infection are rare in the dry season, and take place chiefly in the cold weather (when there is much fog and dew), and to some extent during the rains. Dr. Butler says that no other plant but the palmyra, coconut, and possibly, areca, palms are known to harbour the fungus, and infection from palm to palm only need be considered. The conditions necessary for the spread of the disease are:—(1) the exposure of the diseased inner leaf sheaths to the air, with some animal (bird or insect) capable of conveying infective matter; (2) the prevalence of moist of foggy weather or copious dew, to allow of germination of the spores.

THE TREATMENT RECOMMENDED.

The first circumstance can be prevented by destroying all diseased heads in the early stages, before the "cabbage" falls apart; the second is beyond human control, except that poison can be applied to the seat of new infection; on these considerations the treatment is based.

All diseased tops are cut off and burnt, then all neighbouring trees, for a radius of about 25 yards around each cut tree, have the exterior leaf sheaths sprayed and swabbed with Bordeaux mixture fungicide (copper sulphate and lime mixture). Dr. Butler, however, has recommended in Southern India, that the Bordeaux mixture treatment, which has been in operation some months, be abandoned, and cutting diseased trees only be carried out; for this "if persevered with, will alone check the sources of infection...I am confident that the burning of diseased tops thoroughly carried out, will in itself be sufficient to check the disease."

Every effort is being made in Southern India to check the epidemic; for, as Dr. Butler remarks, "It is simply appalling to contemplate the ruin which would result from the introduction of this disease into such a locality as the great coconut forest of the Malabar Coast; the possibility of controlling the disease in so great an area would be very slender. Yet this extension to the great coconut areas of Southern India is not only possible but even likely. The history of plant epidemics is full of such cases of gradual extension from small forms of infection, and it is but very rarely that an opportunity arises, such as in this case, of checking the danger in its commencement. A more rapid extension through human agency has also been known in several cases, and is even more to be feared."
—*Tropical Agriculturist Supplement.*

COCONUT DISEASE IN THE WEST INDIES.

THE IMPORTANCE OF DRAINAGE.

We have given particulars on the previous page of the serious wet rot disease attacking coconut palms in Southern India; this is very similar in some respects to the "bud-rot" disease of the West Indies. The editor of the "Journal of the Jamaica Agricultural Society," writing on this disease says, "On the yellowing or stripping of leaves being observed more freely than is natural, a close examination of the tree should be made and especially by sending some one up to examine the bud or "cabbage" of the tree; if there is a brown and slimy appearance with the matter giving off a bad odour, there is need for immediate action." Marshy soil seems bad, as it is mentioned that in such soil "several trees suddenly drooped their leaves which grew quickly dry and rotten until there was nothing left but the crown leaves around the cabbage." For these a useful and easy remedy was found: 'a small bar of common yellow soap and a couple of handfuls of salt were placed in the bud of each of them, and in a short time the trees took on a fresher appearance; new leaves were put out and in two months these trees looked as healthy as any of those in the neighbourhood . . . the symptoms appeared to be just those which are observed in bud-rot'

Of course, the best thing to do in any case where a disease breaks out on a plantation—whether, of coconuts, rubber, cacao, tea or other product —is to get expert advice from the Government officials; and for this a full description of the symptoms and the conditions under which the trees or plants are growing should be sent, if possible with a specimen of the diseased portion. The letter we quote hereafter was written to the authorities by a Jamaica planter; it is not only a typical letter of the sort that is preferred by the authorities, but also gives a clear description of the symptoms in the bud-rot(?) disease:

"I find (1) the first symptom visible is a slight brown discolouration on the back of the centre rib of the heart limb: (2) As each limb appears it is more and more discoloured; (3) A brown stain appears in spots upon the bole of the trees; (4) Later a clear gum appears in great gouts and hardens on each discoloured spot on the bole; (5) All the outer limbs of the tree begin to droop down; (6) The young blossoms of the trees show signs of brown decay. (7) The whole spike of heart leaves leans over and finally droops right out of the tree; (8) The tree is dead.

"I have observed the following also: (1) The trees appear to die in patches of 3 or 4; (2) The trees never die on a hillside, not one; (3) The land where they die has in my case always been of a yellowish clay.

"I have tried the following: (1) Burning the trees as soon as perceived, but have never known a tree to recover; (2) I have cut down several trees; there is *no* decay at the root: (3) I have cut trees at the heart and find a circle of decay running longways through each limb, and the white central undeveloped leaf is quite brown and decayed; (4) I have cut the tree just below the limbs and find no decay there. Is this bud-rot so called? If so, is there a remedy? This is a serious matter as I have already lost 25 trees partially dead or dead, and there are as many as 1,000 trees in the neighbourhood liable to infection."

Pending an expert investigation of the disease on the plantation the owner of the trees was recommended; (1) To send an intelligent boy up the trees attacked to examine and report on the condition of the bud or "cabbage" (2) To drain two rows where trees are attacked. As he states they are never attacked on hillsides drainage at once suggests itself: but on the other hand he states trees attacked, when cut down and examined,

ave had apparently nothing wrong with their roots. Still although the oots themselves may not have shown symptoms of decay, they may yet have een absorbing deleterious acids from the soil, the result of sour conditions hrough lack of drainage. (3) To apply (a) a barrel of woodashes each to a ozen trees, (b) a half barrel of lime to another dozen, both to include trees ttacked. (4) Do nothing to other trees attacked and report result in ix weeks.

DRAINAGE FOR COCONUT ESTATES.

On the important subject of drainage for coconut estates the above- nentioned journal says:—

Stiff soils, above all things, require to be drained, and all need it; on w-lying soils, and those with a too retentive subsoil, no crop can mature roperly where stagnant water lies either on or close to the surface. Stagnant ater saturates the soil completely, to the exclusion of the air, which is uite as necessary to plants as water itself. Deleterious acids too are ormed, but lime put on after draining tends to neutralise the effect of these; t sweetens the soil and makes valuable plant food available. Drainage does ot take away too much water from land, but sufficient is left for the growth f plants leaving space for the circulation of the air as well as the water. n going through the soils to the drains, water percolates through quickly, eaving behind it valuable plant food, so that heavy downpours are not a urse but a blessing on drained land. Some nitrogen, however, is lost in rainage; but it is in fact made up for by that which is left during the assage of the water. In dry weather drained land generally comes off the est especially if the surface is cultivated; it does not shrink, crack, and xpose the roots to the heat of sun and hot winds, like undrained soil, and s sweeter and better in every respect."—*Tropical Agriculturist Supplement.*

REPORT ON THE DESTRUCTION OF COCONUT PALMS BY BEETLES.

Reprinted by permission of Mr. H. N. Ridley of Botanic Gardens, Singapore.

The damage caused by the ravages of two species of beetles in ingapore to the coconut trees has now become so serious, that it is nperative that some steps should be taken to ameliorate the plague ithout delay. For this purpose, I have here collected all the information could, both by personal observation of the habits of these animals, nd by enquiries of the several planters whose estates have been much ffected, and by reference also to published notes in the *Tropical griculturist*, and in a paper published by authority of the Straits Settle- nents Government and written by Dr. Simon, together with the corres- ondence on the subject between the various planters and certain overnment officials.

The Species of beetles.—The two species of beetle which attack palms ere are quite different in appearance and habits and in their method of estruction, although they are usually found together, and must be treated f separately. One is *Oryctes rhinoceros*, commonly known as the rhino- eros, elephant or black beetle, belonging to the group of Lamellicornia. he other is *Rhynchophorus ferrugineus*, known as the red beetle: it is a arge species of weevil. Two other large species of Calandra occur in the sland, both of which prey on some species of palm, but I have not eceived any notice of their attacking coconuts.

Oryctes rhinoceros.—This beetle belongs to the group of Lamellicornia, he larvæ of which live in decaying vegetable matter. In the case of this pecies, the parent beetle deposits its eggs in the decaying stems of

coconut trees, whether still erect or fallen to the ground. So abundant are they, that I have found as many as forty larvæ, nearly all full grown, in about three feet of a rotten palm-stem. But besides this habitat, it is also stated that the larvæ occur in manure pits, cowdung, tan bark, crushed sugarcanes, and other vegetable remains, and also in mangrove mud; and I have received grubs taken from pits of cowdung and from leaf mould, made by accumulating grass, leaves, &c., in a pit, which were quite indistinguishable from those taken from rotten palms. Their existence in mangrove mud seems to me incredible, as it appears highly unsuited for them. I have been unable to get grubs taken from mud, and certainly palms growing near mangrove swamps are not more liable to attack than if they were growing in drier soil. The indentification of larvæ of this group is very difficult, and can only be undertaken by an entomologist, as all the grubs of the larger Lamellicornia beetles are very similar, and there are a number of harmless, and even useful, species of this group in Singapore. I have attemped to rear the grubs, but without success, as they invariably die in confinement in a few days.

Description of the Grub.—The larva is a fleshy white grub from two and a half to three inches long when full grown. The head is rounded, broad, hard, and of a dark chestnut brown colour, and behind it on the next segment is an angular patch of chitine on each side. The body is swollen at the tail, so that the grub can only lie upon its side, as is usual in this class of larvæ. It is covered with short, scattered bristles, most numerous along the sides just below the spiracles. The legs are about half an inch in length, weak, but chitinous, and covered with bristles. The short antennæ are quite hairless, and the jaws are thick and powerful, black, with a single tooth below the sharp cutting point.

Description of the Beetle.—The grub passes into chrysalis state in the tree or the rubbish in which it has spent its life, merely making an oval nest in the rotten wood in which to dose. The chrysalis is large and fleshy, soft and white, and has the form of the perfect insect. It appears to remain but a short time in this state, for chrysalis are very rarely found. Hatched in the tree, it soon makes its way out, and eventually flies off to commence its work of destruction. The beetle varies a good deal in size, but it is easily recognised. Large specimens are nearly 2½ inches in length and very broad, of a dark brown or black colour, the chitinous coat being exceedingly hard. The head in the male is small and provided with a blunt horn curved over towards the back, half an inch long. The thorax is about an inch long and three quarters of an inch broad, very hard and solid: it is smooth, and scooped out in front, so that it slopes towards the head. The back edge of this depression is notched, and there are two small semicircular depressions on either side of the large one. The wing cases do not cover the body completely: they are broad and oblong and raised over the back, smooth and shining, but dotted all over with minute punctures. The under side of the body is red-brown, mostly hairless, but the mouth and all the face in front of the horn is covered with red hairs. The legs are strong and stout, the second joint being armed with sharp teeth, with the aid of which the beetle can tear its way into the tree. The female insect can be distinguished by its very short horn, not a quarter of an inch long, and by the much smaller depression in the thorax, which is not notched at the back, as it is in the male, than which, too, it is usually smaller. The insects fly briskly at dusk, rather high in the air, attacking the palm tree at night.

Destruction of Trees.—The grub of this insect is quite harmless, and indeed rather beneficial than otherwise, as it assists to convert rotting wood and other vegetable refuse into soil. It is the perfect insect that it so destructive. Its method of attack is as follows:—It flies by night to a palm, and makes its way to the base of a leaf-stalk, and burrows into the heart of the cabbage, making a large hole, from

hich projects a quantity of the fibre of the tree resembling tow. The pearance of a tuft of this is evidence that the beetle has been at ork. It remains in the hole usually all the next day and may be ptured in the burrow. It nibbles in so deeply, that, not rarely, bites through the growing point in the cabbage, or bud of the lm. More often, the attack is repeated till the rain getting into e burrows sets up decay, which rots the palm through. In either case e tree speedily dies. A tree once attacked seems to be very popular, and have known palms from which two or three beetles a day could be taken gularly in spite of all attempts to drive them away by the aid of carbolic id, salt and other substances.

The following species of palm, besides the coconut, have been attacked, d some destroyed, in the Botanic Gardens:—*Cocos plumosa*, *Martinezia ryotæfolia*, *Corypha gebanga*, *Phœnix dactylifera*, *Livistona chinensis*, *rschaffeltia splendia*, *Areca rubia*, *Hyophorbe amaricaulis*, *Elæis ineensis*, *Sabdalum braculifera*, *Borassus flabelliformis*, and several others, t the Betel nut (*Areca catechu*), the Gomuti (*Arenga saccharifera*), the go palm (*Sagus Rumphii*), and the slender-stemmed palms, seem never be attacked. I once found a beetle in the act of gnawing through e leaf stalk of a species of Cycad, mistaking it evidently for a palm-tree. appears that the object of the beetle in thus attacking the trees is drink the sweet sap in the bud of the palm.

It is very easy to distinguish trees that have been attacked by this etle by the peculiar ragged appearance of the leaves. The beetle burrowing into the bud, often bites straight through the folded leaf the cabbage, so that when it is unfolded the top is found to be ten symmetrically off or each leaflet is perforated regularly. By these pearances, it is easy to tell whether a tree has been attacked or not, d so to judge of the state of the plantation.

I observed that the trees most liable to attack are those in the neighbour-ods of towns. Small isolated patches round the Malay villages in the erior of the island are usually quite free from the attacks, even though plantations are near mangrove swamps. It has been said that in this sition the trees always suffer, and that the grubs are bred in mangrove d. This is erroneous. I have seen many plantations near mangrove amps without any trace of damage from beetles, and it is exceedingly probable that the grubs are able to live in mangrove mud. When a ntation is abandoned or neglected, as soon as one or two trees die, e beetles come to attack and lay their eggs in the decaying stumps. om one tree they fly to another, and soon the whole plantation is in lying state, and if there be any other estates near at hand, the beetle es on to them, and will do a great deal of damage.

It would be easy enough in a clean-kept estate to keep down the etles, but where there is an endless supply of them in an adjoining ate, the matter is of great difficulty, and the destruction is something narkable. A rotten coconut tree lasts a very long time in a state of ay, and over a thousand beetles could be bred from one before it was te destroyed. Not only do the grubs live in the erect and fallen stems, the butts left in the ground are often full of them, and I have even n them in the timber of little bridges made of two or three pieces of onut stem laid across a ditch in a plantation.

Other timber they do not attack, as it does not decay into the powdery, t mass that they require for the grub to live in.

Methods of Destruction. The usual method of destruction of this ect in the trees, is to employ men to examine the bases of the leaf stalks the palms frequently, and to search for the beetles. They are pro ed with a flexible iron or copper wire terminated by a barb, with which beetle is speared in its burrow, and drawn out. A tree once attacked uld be frequently examined, as it is more liable to future attacks than

those which have never been attacked. So long as the beetle is killed by spear, there is no real need to extract it: in fact it is, to a certain extent, advantageous to leave its remains in the hole, as no beetles will again enter the hole while the dead one is there. In any case, it is advisable to plug the holes with bits of rag or tufts of fibre dipped in weak carbolic acid, as this will deter beetles. Many planters affirm that putting salt in the crown of the tree will keep away beetles. I have not found this remarkably successful. Probably the salt is indirectly beneficial by being washed down to the roots by the rains, and there absorbed, and as anything that improves the health of a tree enables it also to resist and recover from the attacks of insects, the manuring by salt in this manner is of advantage indirectly against the pest. Kerosine and phenyl may also be used in place of carbolic acid, but they are less effective.

Another method of destruction consists in making large fires of the fallen leaves and husks in the plantations at night. The brilliant light of the fires attracts the beetles, which are beaten into the fires by men and boys armed with branches of trees.

Plan for Extermination.—Although it is obvious that there will always be sufficient food in the form of decaying vegetable matter to supply the needs of the beetle, so that it is really impossible to exterminate it, its numbers can be very greatly reduced by destroying in or near plantations, all rubbish, leaves, husks and other vegetable refuse, or at least not allowing piles of it to accumulate. All dead trees should be cut into small pieces and burnt. And whereas it is absolutely useless for any cultivator to keep his plantations clear of rubbish in which beetles may breed, while his neighbour has so neglected his trees that they become merely nests of beetles, it should be made compulsory on every cultivator of coconuts, to however small on extent, to destroy by fire all dead trees on his grounds; nor should he be permitted even to utilise them as bridges or posts in the plantations.

Rhynchophorus ferrugineus, the Red Beetle.—This is almost more destructive than the preceding kind and attacks the palms in quite a different method. It is here not the perfect insect, but the grub that does the injuries.

Like the black beetle, the red weevil is nocturnal in its habits, flying at night to deposit its eggs in the coconut trees. Possessed of a remarkably long ovipositor, it finds its way to the base of the leaf-stalk of the palm, and pushes the eggs as deeply into the body of the tree as it can. It frequently makes use of the holes made by the elephant beetle, and can often be extracted thence by the beetle-spear. The egg, on hatching, produces a white footless grub, entirely different in appearance to that of the elephant beetle. It burrows tunnels through the soft growing portion of the palm, and when full-grown nibbles its way to the surface, and forming an egg-shaped cocoon becomes a chrysalis, and eventually hatches out into the perfect insect. Some persons affirm that the beetle lays its eggs in the base of the tree, and that the grubs then burrow upwards. I have seen no case of this, nor have I ever see the beetle at the foot of the tree, unless the palm happened to be stemless. In all the trees affected by the red beetle, that I have cut up, I found grubs only in the soft pithy wood at the base of the cabbage, and here they were sometimes thickly crowded together. I have certainly seen burrows made by some insect in the old stems of the coco palm, but I do not believe that they were the work of this animal, but, probably of some Longicorn beetle, several species of which occur here and the grubs of which eat hard wood.

Like the elephant beetle, this species attacks also other palms besides the coconut, many of those mentioned as attacked by the former in the Botanic Gardens having also been attacked by the latter.

It is by no means so easy to find out when a palm is attacked by this insect, as it is in the case of the preceding. It works entirely inside the

ree. and makes little or no external marks. By listening at the side of the ree the grub can be heard gnawing the wood. But usually the withering nd fall of the central shoot is the first sign that anything is wrong. In ome cases a tree exudes a shiny liquid having an unpleasant sour smell, vhich is a sign of serious damage.

Description of the Grub.—The grub is a thick, fleshy, cylindrical, paque white larva, with no feet or antennæ, quite hairless, except for ome scattered hairs on the head and also a few on the tail. The head is mall in proportion to the body, oblong and black, with small jaws. The egment next to the head is horny, but softer and paler than the head, rith some subtriangular darker patches on either side. The body is urved and wrinkled, and almost equally thick throughout. The tail ends in flat, squared process, with a few tubercles on which there are hairs. 'he grub lives in the burrows which it makes, and which are full of slimy ap exuded from the injured wood. It moves about by the aid of its nickened segments, and usually burrows transversely through the tree. Vhen full grown it attains a length of a little over two inches.

The perfect Insect.—The perfect insect varies a good deal in size and olouring. Usually about two inches in length, but often not more than ne and a half from the tip of the snout to the end of the tail. Like all eevils, it possesses a long curved snout, which is blunt at the top, and in ne male, ornamented with a kind of brush of reddish hairs. The head is ery small, and usually more or less red.

The thorax, broadest behind and narrowed in front, is black, with a road red band in the centre, smooth and polished. The wing cases are lack, sometimes ornamented with red, grooved longitudinally, and square nd blunt at the ends, a good deal shorter than the body. The tail is lack, edged with reddish fur beneath. The legs are strong, rather long, lack, with a strong claw on the end of the second joint, besides the vo small ones on the feet. The antennæ are a little shorter than the nout, abruptly bent in the middle, and ending in a club.

It is the smallest of the palm-weevils here, and easily known by the olouring. It flies at night, but is rarely seen on the wing.

Method of Destruction and Prevention.—This insect, as has been stated bove, is a much more difficult one to deal with, but several of the ethods in use for the former species will be equally effective with the tter. The insects, both male and female, may often be found at the ase of the leaves, and can be extracted with the beetle-spear before ne eggs are laid. They may also be destroyed by fires, as in the case the black beetle.

Some planters have recommended cutting away the fibrous sheath hich surrounds the young stem of the palm, and, as they say, trimming nd cleaning the palm. But the result is attended with a certain amount danger. For there is great risk that the trimmer will accidentally ound the tree with his knife, and the beetle is quick to take advantage this and to deposit its eggs in the cut. I quote from *All about the oconut Palm* by Messrs. Ferguson of Colombo, p. 12:—

"Scores of instances might be recorded where, till the trees were come to bearing, a red beetle was never seen, but no sooner was the land eared and the trees trimmed than it made its appearance and became ry destructive. On one property, the trimming system had been carried for years, till indeed more than one-third of the original plants perished efore the estate was ten years old, and they were going at the rate of ree trees weekly. The work of trimming was stopped for the reason ferred above; the loss of trees continued for some time afterwards, but the end of six months it had entirely ceased."

The cutting of notches by climbers in the trunk of the trees has been id to be injurious, under the impression that the red beetle may deposit eggs in the notches, but, as previously stated, it does not attack old

wood. that being too hard for the grub, and besides were it to deposit its eggs on the trunk of the tree, it would be exposed to the attacks of birds and bats during the operation. It certainly, however, does take advantage of the holes made by the elephant beetle, and it is very common to find both kinds of beetle in the same holes. It is very probable that the extermination of the black beetle will greatly reduce the number of the red one, by preventing their getting into the heart of the tree by means of the burrows of the black beetle.

Many planters are of opinion that a tree once attacked by the red beetle should be immediately destroyed, on the grounds that the tree is doomed and the grubs in the tree can then be killed. But a very considerable proportion of the trees attacked recover. Unless one or more of the grubs bore through the growing point at the base of the cabbage, or set up decay in the heart of it, the palm has a very good chance of recovery. At the same time, a tree once attacked is usually liable to further attacks from both kinds of beetles, and unless it is really a valuable tree, it is perhaps hardly worth attempting to save it. It is hardly necessary to state that when the central bud is destroyed, the palm cannot recover, and is practically dead. In this case, it should be destroyed at once, and the top cut out in order to find the grubs before they escape as beetles. Cutting the grubs out has been tried by several planters, and spearing them through the stem would be equally effective, but the results seem hardly to be worth the trouble. The grub when detected is usually at least half grown, and then deep within the tree, so that the tree has to be very deeply cut into to get at it, and probably this would set up internal decay.

Summary.—It is quite clear that, although it would be impossible to absolutely exterminate every beetle in the place, it will be possible to so far reduce their numbers that the damage done by them is infinitesimal. The large planters may be trusted to keep their plantations clean of any rubbish in which the black beetle may be propagated, and to destroy all dead and decaying palms on the estate, but that will avail little if other persons are permitted to leave dead trees, and piles of tan bark, manure heaps, rotten sugar-cane, &c., in the vicinity of the coconut estates, where the elephant beetle may be bred in large numbers. The small cultivator, to whom the loss of a few coconut trees is of little importance, should not be permitted to let them get into such a state that they are a source of danger to those of others.

It should be made compulsory upon every person owning coconut trees to cut down and burn all palm-trees that are dead upon the ground at once, nor should he be permitted to stack or store the stems in such manner that they can rot upon the ground, nor to use them for bridges or posts.

It should also be prohibited to owners of tan-works, sugar factories, or other persons in whose trade large masses of vegetable *débris* form a by-product, to permit this refuse to accumulate in such a manner that it threatens the safety of any estate of coconuts. As the beetles do not, as a rule, fly to any very great distance, there are spots in which such accumulations would be absolutely harmless, being too far distant from any coconuts to send beetles to them, and as in some professions the destruction of such waste might be found very expensive, and perhaps injurious to trade, it might perhaps be preferable to merely indict any persons owning such refuse as having a nuisance on his property, should it be shown that any of his neighbour's coconut trees were suffering from the ravages of elephant beetles; and should grubs be found in the deposit he should then be compelled to destroy it.

If these steps are taken, I believe that the injury to the trees caused by the beetle will be mitigated to a very large extent, and the pest almost eradicated.

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THE RED WEEVIL ON COCONUT ESTATES.

[BY AN OLD PLANTER.]

It is forty-seven years, since I took up my first charge of a coconut eld, then about fifteen years old, and then made my first acquaintance vith the red coconut weevil. The place had suffered terribly from this pest, and well nigh one-third of the original plants had been destroyed and many of the supplies had gone the same way. I enquired why so nany young trees had broken down; *Kanda-panuwa*, was the reply. And vhat are those holes in the oldest trees? *Kanda-panuwa* again! Two oolies had been employed constantly for years, in what was called beeting; they knocked off the leaves from the stems with cutties, making vounds at every cut, and used ladders to get at the higher trees and cut hose holes in the stems.

I set myself to study the subject for myself, and very soon became onvinced that the treatment was altogether wrong, and suspended the beetlers. I satisfied myself that that insect had no means to make a hole n the stem, in which to deposit its eggs, and could make use for its purpose of a natural crack, or an artificial wound only. The leaf stems, formed n imbricated cover to the main stem, and protected it from exposure o the air which would cause it to crack wide enough for the purpose of the insect, and that the removal of the long stem could hardly be done vithout inflicting wounds, thus giving the enemy a free hand. All the plants that had fallen, and been left where they fell, were cut up and burned, and thousands of grubs destroyed; and at the end of three nonths the plague had ceased to give any trouble. It may not be possible to serve every tree in a plantation, as the weevil regularly tries every nch of the surface of the stems, seeking for an entrance for its eggs, and will often find some weak point. The most common way is when the expansion of the stem bursts a green leaf at its base and makes a large crack, suitable for the insertion of the ovipositor, and the young grub finds enough of its natural food in the leaf-stem till it is strong enough to cut its way into the main stem. Then it makes its way upwards and inwards, enlarging its passage as it goes, till at a certain stage of its growth, it turns towards the surface, where, having eaten and cut the fibre till the outer skin of the stem is as thin as writing paper, it wraps itself in fibre cocoon and awaits its transformation. The perfect insect can easily burst the thin outer skin, and emerge to commence its life work of propagation.

The danger from this pest begins when the stem comes above ground about the fifth year, and continues till it begins to flower, by which time the stem becomes too hard to be food for the grub. In my early experiments, I continued the practice of cutting out; but, though I tried many things, I did not succeed in preventing the further exploiting of the tree. Only where they had reached a point, where the stem was too hard for them, I soon gave up the cutting out business. It deformed the tree, and permanently weakened it, and I do not think any one can boast of the crop produced by a tree so treated. In all my subsequent dealings with the weevil, I rooted out every plant in which I found it established, and chopping well into chips subjected it to fire, so as to destroy every living grub great or small. The frond part of the leaf may be cut off, when it withers, but leave the base untouched when it has fulfilled its office of protecting the main stem, till it is hard enough to face the weather without cracking. As soon as watchful inspection discloses the presence of the grub, spare not the tree; the war is not of mitigation but of extermination, and the sacrifice of one may be the safety of a thousand. When a crack is detected in the base of a green leaf, fill it promptly with sand and tar, for it is not safe to leave it open for one night.

I do not think the weevil will be attracted by any stinking ferments: this is more in the way of the cockchafer that may possibly use it as a hatching medium. In the case of the big black beetle, the grubs are to be found in dung heaps, and in decayed vegetable rubbish, and such like, and should be hunted for and destroyed wherever found. The perfect insect enters at the top of the tree and eats into undeveloped leaves, and is the cause of the clipt and rugged appearance of the trees they attack, but they are less destructive here than in the Straits Settlements, where they appear to be the coconut beetle *par excellence*.

[NOTE.—If the Carbon Bisulphide proves a success it will supersede all other treatment of the red-weevil.]—W. L:—*Tropical Agriculturist*.

COCONUTS AND THEIR ENEMIES.

By FRANCIS BEVEN.

(*Paper read before the Agricultural Society.*)

I should wish to say a few words in explanation of my consent to address you on the subject of coconut trees and beetles. The learned Director of the Royal Botanic Gardens explained at the meeting last month, that he then departed from the rule of his department, in suggesting the experimental cultivation of products which had not previously passed the test of experiments by himself or one of his staff. The advantage of cautious suggestion and discussion was thus recognised. When I was asked to read a paper on "The damage done to Coconut Trees by Beetles, and the powers needed to check it," I felt it would be ungracious to refuse—after the readiness with which their stores of knowledge, experience and observation had been placed before the Society by others—simply because I could not claim to be an expert. I do not profess to know more about beetles and the damage they do to coconut plantations than other owners of estates. My observations have not been very prolonged; and I am happy to think that destructive beetles and weevils have not been particularly persistent in their attentions to me and my plantations. But my remarks may lead to observations from others which—though I may not be privileged to follow them at once or to answer them—will be published, through the courtesy of the Press, and thus contribute to the common stock of knowledge in very desirable directions.

Roughly speaking, there are only two species of beetles which do any considerable damage to coconut plantations. One is the common black beetle, which thrives in dung heaps and under dead wood, and is an unwelcome visitor to the bungalow on a showery night. It is known to scientists as *Oryctes rhinoceros*; and those who like a formidable name call it the rhinoceros or elephant beetle, though the rhinoceros is not exactly an elephant. But the beetle is really not as formidable as it looks, or as its name implies; and I have never known a tree killed by it. The drawback about it is that it flies high, and is, therefore, an enemy, though not a deadly one, both to the fullgrown tree and to the plant. I can quite conceive its killing a tree: but in my experience it is content to transfer its affections from tree to tree, before it falls a victim to its many enemies, after it has damaged the unopened frond and even had a taste of the heart. The tree or plant attacked by it presents a sorry appearance with its frayed and tattered leaves; and there are some who say, though I do not share their optimism, that a plant is all the better for an attack of black beetle, which calls forth its latent vitality, sets up its back in fact, and makes it anxious to live! That is not, however, how it strikes a stranger. I had a very nervous letter once from a Kelani Valley planter, who had drawn his seed nuts from me, and was seriously alarmed by the tattered foliage of his vigorous plants when they were three or four years old. I assured him it could not be

the deadly beetle, which kills unobserved, but the black beetle, which allows itself to be easily killed by the aid of a pointed iron rod which transfixes *in situ*, in the hole it has made for itself in the stem, or by a hooked wire which will draw it out of its shelter. I advised consultation with the lowcountry Sinhalese carters or carpenters on the estate, who would probably know all about it. I learnt soon after that the beetle had been traced and destroyed as suggested, and that they had done no permanent harm.

But the permanent mischief they can do is in leaving an opening for the work of the red beetle; and of this I had unpleasant evidence recently in the fate of a heavy-bearing King-coconut tree. This variety of the *Cocos nucifera* bears only in alternate years; and when it rests, blossomless, for twelve months, it seems particularly susceptible to attack from the black beetle. The larger trees recover rapidly from the attack without treatment, and bear heavily, but on the unexpected collapse of one tree the head was examined, and was found to swarm with red beetles. This unpleasant experience confirms the theory, which some reject, that the comparatively harmless black beetle often paves the way for the specially destructive red beetle, and it is also at variance with general belief, which I still share, that the red beetle cannot or does not fly high. But this exceptional case, in which the red beetle probably crawled up an eight feet stem, attracted by the smell of the unopened frond, if not of the heart, on which the black beetle was feeding, proves the wisdom of relieving even trees in bearing of the too persistent attentions of the black beetle.

I now come to the red beetle known to science as *Rhynchophorus ferrugineus*—which is the true enemy of the coconut tree—or rather plant. It is really not a beetle, but a big weevil—from an inch to an-inch-and-a half long—and furnished with a strong curved snout and a wiry ovipositor. It is not necessary I should describe the insect at any length—a full description of it, as well as of the black beetle, with illustrations, is to be found in the useful manual "*All about the Coconut Palm*," but I may mention some of the features which constitute it the serious enemy it is to the coconut planter. It differs from the black beetle in two important particulars—1st, that its operations are generally invisible, and not easy of detection; 2nd, that if they are not arrested, they inevitably result in the destruction of the tree. The black beetle, in gnawing an unopened leaf, or in making its way into the tip or base of a tender leaf stalk, and thence into the heart, has to burrow a largish hole from which projects the fibre it has cleared out. This indicates its presence even before ragged leaves proclaim its work. In a young plantation it is not difficult for a band of boys and girls to travel in rows, armed with beetle spear of stiff hooked wire, transfix the beetles in their holes, and fish them out, to be produced, threaded in *ekels*, in order to claim their reward. But the red beetle leaves no tell-tale fibre at the mouth of an easily-discovered hole. It works upwards generally from the imbricated leaf stalks below. Its habits, like those of the black beetle, are nocturnal; but it takes advantage of any crack or injury in the soft stem of a young plant or in the base of a leaf stalk, to deposit its eggs in it, being aided in its mischief by a particularly long ovipositor. The grub, when hatched, tunnels its way into the tender fleshly leaf stalk, and right into the heart, and the first intimation one often has that aught is amiss is when the top of a plant just coming into bearing topples off. It is then one discovers that the mischief has been done by about a dozen or two of full-grown beetles, aided by quite an army of creamy larvæ, in all stages of growth—some, just before attaining the chrysalis state, within cocoons formed of the fibre carded off the tender portions of the leaves and stems. It is often impossible by the sight alone to detect the presence of the enemy until the collapse of his citadel; but the observant planter may be guided by the unhealthy appearance of a tree, or by the sour smell proceeding from it, and be able to examine it more closely, and then if his ear is keener

than mine, he will, on placing it against the stem, detect the gnawing within. The catty has then to be freely used to cut out the part attacked, and if the injury to the heart has not been too extensive, the wound, after the application of coal-tar to it, has to be filled with well-kneaded clay and the surface tarred. Periodical visits are necessary to the tree to ascertain whether any grubs, inadvertently left behind, are carrying on their deadly work—and this can be detected only by placing the ear against the tree—or whether a persistent weevil has found its way back to its strong-hold, and this is generally indicated by a hole in the mud plastering. While the extent to which a tree can be cut into, and its life be yet saved, is truly marvellous, it must not be forgotten that the attempt at conservative surgery must fail even if a single weevil or grub be left in the tree. I do not agree with those who think that the best course is to destroy a tree once attacked. It is not easy to consign to destruction the growth of seven or eight years, just when the fruit of one's labours seems to be in sight; and most of the trees I have helped to save have proved worth saving. On the other hand, the percentage of successes, in my experience, has been smaller than that claimed by some Kurunegala planters.

As regards preventive measures, I am afraid the burning of all dead wood in a new clearing is a counsel of perfection, and, with the numerous enemies that the black beetle and its grubs have in rats, pigs, porcupines and crows, it is not necessary, in the districts with which I am acquainted; but the regular hunting of black beetles in a young plantation is necessary, not only on æsthetic grounds, as a safeguard against ragged tattered leaves, but also in order to prevent the way being paved by them for the red weevil. The best means of checking the ravages of red weevil, apart from attracting them to their destruction by toddy in pots, tender coconut husks, and fires, I have already described; and it cannot be insisted on too strongly that a tree that is down, or that is doomed to destruction, must be destroyed to *ashes*. Unless every leaf stalk is ripped open at the base before it is thrown into the fire, the escape of some grubs wrapped in their cocoons deep in the stalk is inevitable. It is the danger which explains, and in some measure justifies, the demand that was made some time ago for legislation. The owner of a garden should not be free to think that the loss of a tree belonging to him is only his affair. If he has trees of the same age as the one destroyed by beetles, or younger trees, it is to his own interest that the fallen tree, and every weevil and grub in it, should be reduced to ashes. If his trees are old enough to be practically free from attack, he owes a duty to his neighbours, and the duty is one which should be enforceable by law. It is the steady extension of young coconut plantations which renders legislation desirable. So far as I know, it was the Batticaloa planters, who under stress of unpleasant experience, *first* asked for legislation a couple of years ago, but the agitation has subsided. Time has probably worked a cure. Their own plants, may be, as they developed a tough stem, proved impervious to attack, and their own vigilance reduced the number of beetles and larvæ. Still, individuals are liable to serious loss and their protection must inure to the common good. What, then, should be the course of legislation?

(1.) Holding as I do that the black beetle is comparatively harmless, and that its work is open to view and can be checked, I do not think it necessary to bring it within the purview of the law. If the general cleanliness of gardens as a sanitary measure be enforced, the black beetle will be kept in hand sufficiently.

(2.) The legislation against the red beetle might take the form of a requirement that every fallen coconut tree, as to its head and three feet of stem, and every plant which collapses under the attack of beetles, should at once be cut up into pieces and burnt. The incineration will cover every black beetle in the stem as well, and probably many from

neighbouring trees attracted by the fire, if it lasts a little after dusk. The mere knowledge that there is such a law will in most cases, lead to the prompt destruction of fallen trees; but it should be made the duty of the village headman to inform himself of trees in his village attacked by the red weevil or *Kandapanuva*. If the owner fail, on his request, to burn the tree, he is to do it himself, and then charge the man before the Gansabhawa or the Police Court. If half of the fine imposed be paid to the informer, there will be an incentive to exertion. That is all in my view that is needed.

DISCUSSION.

THE CHAIRMAN: Mr. Beven, do I understand you to say that legislation had been proposed in this connection?

Mr. BEVEN: -Yes; by the Batticaloa planters. The matter then came before the Ceylon Planters' Association, and the agitation has since subsided.

THE CHAIRMAN:—When is the matter likely to come up again?

Mr. BEVEN:—I do not know. I thought if there were legislation it need not take a particularly wide scope.

THE CHAIRMAN:—Do any members present wish to say anything on the very interesting paper Mr. Beven has just read to us?

Mr. E. E. GREEN:—I think, with reference to what Mr. Beven said regarding legislation, I may assure you that the question of legislation has not subsided. The matter is still in the hands of the Government. It was held back for a certain time in order to permit the inclusion of all kinds of insect pests, instead of coconut beetles only. The matter is still being considered by the proper authorities, and it will be brought forward shortly. I think I understood Mr. Beven to say that the red beetle did not fly high. I have seen it fly at a height of any ordinary coconut tree, although it usually attacks young trees. It is quite true, as Mr. Beven said, that the trees suffered by the holes made by the black beetles, through the red beetles being attracted by the scent of the fermented sap. It is advisable, after extracting the black beetle, to stop the opening and apply tar on the surface, as this obliterates the scent of the sap and prevents a possible attack by red beetle.

THE CHAIRMAN:—I think Mr. Beven mentioned the covering of the hole by the application of tar.

Mr. GREEN:—I do not think in Ceylon it has been customary to do anything to prevent the red beetle following black beetle. I should like to mention, however, that I have had considerable success in treating young coconut trees attacked by beetle by injecting bi-sulphide of carbon, but it is extremely difficult to get in Ceylon. I treated three trees at Peradeniya before going home last year; and I have since learned that two of these recovered completely, and there were no further signs of beetle. The other was too far gone. It was nearly a forlorn hope. I have found the red beetle in the base of larger trees—trees in which six or eight feet of stem had been formed. It will be of very great benefit, indeed, if we can get sufficient bi-sulphide of carbon to treat trees in that way because the present method of chiselling out almost the whole heart of a tree after a grub which had tunnelled into it, is most injurious to the tree. The ordinary treatment frequently sets up fermentation in the tree. I do not doubt that the bi-sulphide of carbon treatment for red beetle is the best if we can get sufficient material. In the Straits there was talk of erecting a small still. At present shippers will not touch this chemical, it is so inflammable. I should wish to ask Mr. Beven what amount of success he had in trapping beetles with the toddy mentioned?

DR. H. M. FERNANDO said that in connection with the paper of Mr. Beven he wished to make a few remarks from his own experience. He

agreed with Mr. Beven that the rhinoceros beetle did not produce serious damage to coconut plants. It only destroyed the leaves, except in certain situations, he remembered no cases where it destroyed young plants and prevented growth for several years. These were round the margin of the lake and the borders of the lagoons in the Chilaw and Puttalam districts. In these districts on young plantations they had to systematically kill the rhinoceros beetles to keep the young plants alive. Their attacks were so serious as to prevent growth and effect destruction. The same, he thought, was experienced in Selangor in the Malay States. As far as the red beetle was concerned, he agreed with everything Mr. Beven said as to their destructive habits and method of treatment. But there was a point he wished to mention in connection with the life history of the coconut palm, and that was that the beetles only attacked the trees about the time they came of age—at the period that they were about to blossom or fruit. That was a remarkable feature about the red beetle, and it was probably on account of that that Mr. Beven mentioned the fact that he thought the beetles did not fly high, and therefore did not get at the taller trees. On the other hand they did not attack young plants two or three years old, even if the trunk had been formed. It was only about the time the trees came into bearing that the red beetles attacked them. That was a fact which required thorough explanation if they were going to check it. Another feature about the red beetles was that they were more numerous and more destructive where the soil was rich and suitable for the growth of coconut plants—places where the coconut trees had great girth. They also heard a great deal of discussion about the red beetle and its ravages in young coconut districts. Planters kept on agitating for two or three years, and then they heard nothing more. That coincided with the fact that where new districts were being developed and a large number of trees coming into bearing, there the most pests occurred. Some believed that the pests attacked the trees at the time of bearing fruit, due to the fact that there seemed to be a rapid growth in that stage of the life history of the palm. In connection with the rapid growth of the tree it was believed by some people that the bark cracked and in that way induced the attack of the red beetle. In connection with the question Mr. Green put to Mr. Beven as to the success in trapping beetles, he might mention that he tried it on two or three occasions and found the method successful in only attracting the rhinoceros beetle. He never saw a red beetle trapped.

The Hon. Mr. S. C. Obeyesekere remarked with regard to the red beetle he agreed with Mr. Beven as to the mode of attack. With regard to Dr. Fernando's remarks about those trees round lakes and lagoons, the explanation was simple. The red beetles attacked the most healthy plants on an estate. On the banks of lagoons and lakes, with their alluvial soil, the coconut plants flourished remarkably well—in fact better than in other localities. The best plants on an estate were attacked by the red beetle. There was something in what Dr. Fernando said about the plants which had the greatest growth, and throve more luxuriantly than others, being more liable to attack. Very probably the bark cracked and from the cracks exuded a humour which attracted the beetles. He was struck with the remarks made by Mr. Beven. All the remarks he had made were worthy of consideration. With regard to the flight of the beetle he was inclined to disagree with Mr. Beven, because he had seen his own plants, grown to a considerable height, destroyed by red beetle; and the red beetle was no doubt the destructive beetle.

Dr. J. C. Willis said that what Dr. Fernando had said about trees being attacked just about the time they started bearing fruit was rather suggestive of the possibility of the attraction being the sugar. It was a well-known fact that in plants which remained for a long time in the vegetative condition, in green leaf, and then suddenly ran into flower, there was a great deal of sap which contained sugar

and other valuable foods. It was possible in the coconut that that was the case. He had had no evidence of it, but he made the remark from analogy. On the bark cracking there might be sugar coming outside. He wished to know if anyone interested in the subject could give information as to whether the sugar came out at the time the plants came into flower. Probably many people had seen the exudations of sweet gum on coconut trees.

Mr. Beven said that he was under the impression that the trees round the Colombo Lake were attacked by a species of locust. There was some investigation, and it was said that a species of locust was responsible for the mischief. With regard to Mr. Obeyesekere's suggestions, that the red beetle generally chose the healthiest plant for attack, his own explanation was that it was the stem of the well-developed healthy plant which had the greater tendency to crack, and for the leaf stalk to yield, and the cracked leaf stalk attracted the beetle to deposit its eggs in it. The grub then worked its way upwards and made its way to the top of the plant.

The Chairman :—If, as suggested by Dr. Willis, the beetles are attracted by the sugar, then trapping ought to be very successful ; they ought to be easily trapped.

Mr. Green :—With the small experience I have had I have seen the beetle most deadly on trees before there was any question of their coming into bearing. I have seen coconut plants at Peradeniya topple over before any stem had been formed, and have found the stump full of grubs, pupæ and beetles of the red weevil.

Note on the above by the Government Entomologist.

I have frequently seen the red weevil flying at heights equal to that of a full-grown coconut tree, but I have no records of actual damage to such trees. I have, however, found the same insect breeding freely in the top of a cabbage palm (*Oreodoxa regia*) at a height of over 40 feet.

The use of carbon bisulphide obviates the necessity of making a large cavity in the stem of the tree. After application the small hole is plugged with tow and coal-tar, the latter acting as a deterrent against any fresh infection at the same point.

I notice that Mr. Beven is apparently under the impression that weevils are not true beetles. The weevils form a section (*Rhynchophora*) of equal rank with the section *Lamellicornia* which includes the black coconut beetle (*Oryctes rhinoceros*). They are both equally entitled to the name of beetles.—E. E. G. *Tropical Agriculturist & Magazine of the C. A. S*

A NOTE ON COCONUTS AND THEIR ENEMIES.

Mr. T. B. Pohath Kehelpannala sends " A note on Coconuts and their Enemies." As a considerable portion of it dealing with charms and native folk lore—is unsuitable for an agricultural paper, it will be sufficient merely to give a résumé of the paper.

The author points out that Mr. Beven, in his earlier paper on this same subject, omitted to mention one of the principal enemies of the coconut palm, viz., the Porcupine, which the present author considers to be "as great an enemy to coconut cultivation as the beetle." He remarks that "the Porcupine has a particular penchant for tender coconut and rubber plants," and draws attention to the importance of effectually dealing with this dangerous enemy in view of the fact that "Coconuts are the principal product of the low country, and that in a few years time rubber will be as extensively cultivated as tea." After giving particulars of damage to certain young coconut plantations, some methods of de-

troying porcupines are considered. The principal plan employed by the native is to shoot them in the following manner:—"Having kindled a fire in a basket in the shape of a bull's eye lantern, so that the light is focussed to one direction, they place the baskets on their heads, tied by a string under the chin. Clothed in dark apparel and armed with a gun, they set out in the night. The hunter, while being himself in darkness, is yet enabled to see his quarry which is momentarily blinded by the sudden light flashed in its eyes and falls an easy victim." Another plan is to build "a wall of loose stones about three feet in height, round the plant which it is intended to protect." Any attempt to scale the wall results in the downfall of some of the stones, the noise frightening away the animal. The villagers are also said to set traps and spring guns with success.

The work of the porcupine is compared with that of the beetle; while the latter "works slowly and thereby gives one time to discover and destroy it before the tree is past remedy, the porcupine attacks with such quickness and success that the healthy and young plant of last evening is a total and irremediable wreck in the morning.

The author describes two methods for the destruction of the coconut beetles which he affirms to be "practised with apparently equal efficacy. One method is that of entwining long human hair besmeared with cowdung round the fronds, stems or parts affected," which "says a good deal for the superlative self-denial and agricultural zeal of the Kandyan cultivator's wife!" The other is to place below the tree a chatty containing the refuse of the kekuna nut (after extraction of the oil). Both these preparations are said to be irresistibly attractive to the beetles which become entangled in the hair in the one case, and fall into the pot of "mandi" in the other.

To prevent the attacks of white-ants, "a layer of sand and salt is put into the hole," and side by side with the young coconut plant is placed a plant of "Sevendara" (*Andropogon muricatus*, "Cuscus"), or "Habarala" (*Alocasia macrorhiza*) which plants are reputed to be "good antidotes against the raids of the white-ant."

"The wild boar is another enemy. It roots out the young plants and feeds on the imbricated and fleshy leaf-stalks at the base and the contents of the nut."—E. ERNEST GREEN.—*Tropical Agriculturist & Magazine of C.A.S.*

ENTOMOLOGICAL NOTES.

BY E. ERNEST GREEN.

The black-headed Coconut caterpillar (*Nephantis serinopa*, Meyer) is again giving trouble in the Batticaloa district. I am informed that the pest has greatly increased within the last few years, and that, instead of being periodic in its visitations, it now shows a tendency to become chronic. The pest is at its height in March, which (in that locality) corresponds with the termination of the wet season. Removal of the infected fronds has been found impracticable, as it would mean the almost complete defoliation of the trees. My correspondent states that he has been very successful in trapping the moths by means of a powerful acetylene lamp set in a large basin of water with a film of kerosene. He has satisfied himself that the pregnant females are captured, as he has observed them in their dying struggles—laying strings of eggs. The pest more especially affects certain spots on every estate, resulting in the permanent weakening of the trees, some of which even succumb to repeated attacks.

In a valuable paper on 'The Principal Insects Attacking the Coconut Palm,' by C. S. Banks, published in the Philippine Journal of Science, Vol.

I, Nos. 2 and 3, mention is made of native treatment employed against the attacks of the Rhinoceros beetle. This consists in placing sand and coarse salt in the crown of the tree. 'The Filipinos state that the sand gets between the articulations of the head and thorax of the beetle where the constant friction sets up an irritation which eventually punctures the soft tissues, after which the insect dies.' During a recent visit to Trincomalie, I was interested to find that a similar theory is maintained by the local coconut growers. The practice seems to be a sound one, and it might be employed with particular advantage on all young coconut estates. Besides the placing of sand in the crown of the tree, no better material could be employed for filling up the holes after the extraction of the beetles. The loose gritty sand prevents the reoccupation of the holes by other beetles—either Rhinoceros or Red Weevil.

During the latter half of May I made a tour through the coconut districts of Batticaloa to study the pests of the Coconut palm. The following is a list, in the order of their importance, of the insect enemies observed during my visit:—

Black-headed Caterillar (*Nephantis serinopa*, Meyer.)
Red Weevil (*Rhynchophorous signaticollis*, Chevr.)
Black Beetle (*Oryctes rhinoceros*, L.)
Scurfy Scale-bug (*Aspidiotus destructor*, Sign.)
White Scale (*Hemichionaspis minor*, Mask.)

I have given the 'black-headed caterpillar' the first place, because, though not so widely distributed as are the two species of beetle, the attack was very acute at the time of my visit. On two adjoining estates—to the north of Batticaloa town—every single coconut tree was more or less involved, and in the worst parts the fronds were completely skeletonized. On one of these estates the moths were on the wing and were resting on the trees in thousands. They seem to prefer the older drooping fronds. It was remarkable that no moths could be found on the adjoining estate, though the caterpillar was present there in full force. It is evident, from this, that the broods are not synchronous, but appear irregularly. Lamp traps were being employed at night with considerable success. Two kinds of lamps were in use: one—a powerful acetylene burner projecting from the centre of a large tray containing water with a film of kerosene, and others—Small kerosene lamps supported on a brick in the middle of a basin of kerosene and water. The more powerful light naturally attracted the larger number of moths, but the smaller lamps could be distributed more evenly through the fields, and the sum total of their catch was considerably greater than that of the single acetylene lamp. The result of one night's work was 169 moths in the tray of the acetylene lamp, and from 20 to 60 to each of the smaller oil lamps. The size of the tray containing the water and kerosene would seem to be a more important factor than the brightness of the lamp. If of insufficient diameter many of the moths circling round the light escape capture. For practical work a tray of not less than 30 inches diameter should be employed. I am convinced that a large number of small kerosene lamps distributed through the infested area will be more effective than a few more powerful lights.

A certain amount of discredit has been thrown upon the use of lamp traps, it being stated that the resulting catch consists principally of spent males and females that have already deposited their eggs. This is undoubtedly the case with some insects; but it varies with individual species. With regard to moths of this coconut caterpillar, I was able to satisfy myself fully, that fertile females were attracted and captured in large numbers. Dissection of the captured females showed the ovaries to be

densely packed with eggs in different stages of development. The result of such dissection suggested that the eggs are not all laid at one time, but in many small batches. Later experiments with living moths proved that normal batches consisted of from 12 to 20 eggs. The eggs while still in the body of the female are of a greenish tint; but after deposition they are pinkish. It was only after a long search that the natural habitat of the eggs was discovered. They are deposited amongst the frass and debris of the larval galleries, and are more or less masked by a covering of down from the body of the parent moth. The discovery of the position of the eggs is of importance, as it shows that a removal of affected fronds or parts of fronds--besides resulting in the destruction of the existing larvæ and pupae—will get rid of a very large number of eggs that would have given rise to the succeeding generation. There must, however, be other localities for the eggs, as it is clear that, on the first invasion, there would be no larval galleries in which to oviposit. It is possible that the fibrous matter at the base of the young fronds may form a nidus for the eggs. Palmyrah palms suffer equally with the coconut. There are many stunted palmyrahs in the neighbouring scrub, and these are thickly infested by the caterpillars. Such useless palms should be destroyed as they will harbour the pest after it has been eradicated from the coconut estates. It is intended to issue a circular giving the fullest particulars about this pest and the best means of combating it.

The red Weevil and Black Beetle may be considered together as, in Ceylon, they appear to be very largely interdependent upon each other. There seem to be good grounds for believing that the reduction of the Black Coconut Beetle results in a corresponding diminution in the numbers of the Red Weevil. The smell of the fermenting sap that exudes from the holes excavated by the former attracts the latter and affords an easy entrance for it. On the other hand, the decayed stems of palms that have been killed by the Red Weevil form a favourite breeding place for the Black Beetle. The importance of the destruction of such breeding places is not sufficiently realized. Cases have occurred where the estates have been fenced with dead palm stems within which the beetles were breeding in thousands. It will be necessary when the Pest Ordinance comes into force, to insist upon the destruction (preferably by fire) of all dead palms and decaying rubbish.

To the south of Batticaloa several abandoned coconut estates were observed, upon which hundreds of dead palm stems are left standing. The remaining trees are dying fast, probably being killed out by beetle. The dead stems must be breeding enormous numbers of the beetles. Government should be petitioned to take over these places—under the Waste Land ordinance—and put them into a sanitary condition. At present they are a standing menace to the neighbouring estates.

Of the two species of scale bugs (*Coccidae*) frequenting the Coconut Palm the 'scurfy scale' (*Aspidiotus destructor*) is the more serious. It occurs in large colonies covering the undersurface of the fronds. Such fronds may be recognized by their sickly yellow colour, and should be cut off and destroyed. This species is reported to be extremely destructive to Coconut Palms in the Laccadive Islands. The other species (*Hemichionaspis minor*) is of little importance and is unlikely to cause any appreciable injury.—*Tropical Agriculturist and Magazine of the C.A.S.*

COCONUT PESTS IN CEYLON.

Coconut Beetle.—The Ratemahatmaya of Demala hatpattu, in a letter to the Government Agent, North-Western Province suggested an easy and effectual way of destroying coconut beetles. He says:—"Take a quantity of castor seed, say about four measures, pound and extract the oil by boiling with water as is done with the coconut, remove the oil for

use, put the water and the sediments into an earthen vessel with a large mouth, and leave it under a tree on the estate, taking care to close it up during rainy weather. The beetles in the neighbourhood will be attracted to the vessel, fall into it, and die."

The Government Entomologist reports on this:—"It is not stated which kind of coconut beetle (the red or the black one) is attracted by this concoction. If the writer of the letter has experimented, I should be glad to have particulars of the numbers of beetle caught per day in such a trap If he is still using these traps, I should be glad to see specimens of the beetle captured. I propose to try this method on an estate in Peradeniya, where red weevils are troublesome. It will have to capture the beetles in very large numbers to be of real value."

Caterpillars on Coconuts.—Attention was drawn to the ragged appearance of the coconut trees on Captain's Garden, and Agricultural Instructor Wickremeratne, who was sent to inquire into the trouble, reported that the plants were infested with caterpillars The trees are said to be attacked only during the dry weather. and the pest is to some extent being kept down by crows. Specimens of the caterpillars were sent to the Government Entomologist who reported on September 12th as follows:—"The coconut leaves which accompanied your letter of the 11th instant are infested by a black-headed coconut caterpillar (*Nephantia Serinopa*, Meyrick). This pest has hitherto been noticed only in the Batticaloa District. but it has probably been present in other parts of the Island without attracting notice."

Caterpillars have been before noticed on the same area. Inquiries are being made as to its occurrence in other parts of Colombo. Mr. Green advises that if the pest is confined to a few trees, the fronds should be stripped and burnt.—*C. A. S. Progress Report.* xxxiv.

THE BATTICALOA INSECT TROUBLE.

Mr. Green's Report.

From the Government Entomologist, To the Hon. the Colonial Secretary.

Batticaloa, 11th June, 1907.

Sir, I have the honour to report that I left Peradeniya on Wednesday the 3rd instant, reaching Batticaloa on the evening of Saturday the 6th, where I found your telegram of the 1st instant awaiting me.

2 I regret that my report has been unavoidably delayed owing to the absence of several of the more prominent planters of the district. It was not until yesterday (10th inst.) that I was able to hold a meeting to discuss the situation.

3. Meanwhile I employed myself in examining the fallen coconut trees and ascertaining the conditions as regards the development and prevalence of the 'red-beetle' in them.

4. I find that the development of the insect is certainly proceeding at a more rapid rate than I had anticipated. It is still difficult to speak with absolute certainty; but I have found nearly fully grown larvae of the beetle in trees under conditions that indicate that they must have developed within a period of six weeks. It seems possible that the insect may reach maturity in from eight to ten weeks time.

5. At the same time I have been surprised to find that only a very small percentage of the fallen trees is at present attacked by the beetle. On Easter Seaton Estate, which bore the full brunt of the cyclone and has

suffered severely, careful census shows that between 2 and 3 per cent only of the fallen trees is infested. On Nindoor Estate (further south) a percentage of 8 trees to the hundred was estimated, but this higher percentage is greatly accounted for by the fact that the 'cabbages' of the palms had been removed for eating purposes, so affording easy access for the beetles.

6. There has certainly been a very marked increase in the number of beetles captured during the last two months (May and June). Careful records of the captures are kept by the Superintendents. These records show—in one case—1096 beetles captured in these two months of the present the disproportion is still mcre marked, 3,889 beetles having been captured year, against 199 taken during the same period of 1906; while in anothe case in the two months against 138 in the previous year. But this increase is almost entirely in the number of beetles extracted from the standing trees, and affected not only estates that have suffered severely in fallen trees but these younger properties also in which the damage is more partial and confined to the wounding of the crowns of the growing trees. It is supposed (and probably correctly so) that the wounding of the crowns of the trees by the gale has rendered them more liable to infection It seems to be a general rule—that given an ample supply of easily available food—an insect is able to take advantage of it by more rapid multiplication. Under ordinary circumstances the trees are to a great extent protected by the close growth and imbricate habit of the bases of the fronds. The cyclone has disturbed this arrangement and so induced the present susceptible condition of the trees.

7. Though, from my investigations, I am of opinion that the presence of the fallen trees is at present only a very small factor in the recognised increase in beetle infestation, it will no doubt become a much more serious factor month by month, and it is most important that measures to eliminate this source of infection should be promptly undertaken. This will not necessitate the immediate destruction of the whole trees. It is only the tops and about six feet of the mature trees (from 25 years and upwards), the tops and about 10 feet of trees between 15 and 25 years, and the whole stem of all younger trees that are liable to immediate infection.

8. The best means of destruction has been a matter of careful consideration. The work so far attempted by the European planters has been the removal and burning of the crowns and a few feet of the upper part of the stems; but this work has now ceased pending the decision of the Government with regard to assistance. Moreover this burning is of a very partial nature and has resulted only in the destruction of the foliage and the charring of the other parts of the remainder. This can be regarded only as a temporary measure. I have already observed several cases of reinfection of these half-burnt crowns. The complete destruction of these parts will be necessary. A second burning will be difficult owing to the scarcity of suitable fuel, and they are still too full of sap to take fire.

9. After consultation with the local planters. I have come to the conclusion that a preliminary burning (to get rid of the foliage and leaf stalks) followed by the burial of the residue, will be the most economical and practical method of dealing with this material. The soil is loose and sandy, so that large holes can be quickly and easily dug. If buried a foot below ground level the material will be rendered quite harmless.

10. The removal of the main stems will be a more troublesome matter but is one that can be quite safely deferred untill the upper and more dangerous parts have been disposed of. The wood of these old stems is quite hard and will remain impervious to beetle for many months. It will never afford any attraction to the red beetle (*Rhynchophorus*), but—as it decays—will gradually become infested by the larvæ of the Rhinoceros beetle (*Oryctes*). In their present condition it has been found practically

A DEVASTATED COCONUT ESTATE NEAR BATTICALOA, EASTERN PROVINCE, CEYLON.
THE EFFECT OF THE CYCLONE ON MARCH 10TH, 1907.

impossible to destroy the old stems by fire. If split and exposed for several weeks, they might, perhaps, be burnt; but they are so hard and dense that the cost of such treatment would be prohibitive. It was found by actual experiment, that three men working with axes and steel-wedges took 35 minutes to split an eight-foot log. As some of these stems are from 40 to 50 feet in length, it would be a hard day's work for one man to cut into sections and split a single tree, to say nothing of the subsequent labour of piling and burning the pieces. Experiments are now in progress to see if the wood can be conveniently converted into charcoal; but I feel certain that the easiest method of disposing of these stems will be to cut them into sections of about 10 feet and to bury them in the same manner as has been suggested for the upper parts.

11. I find that a certain number of the stems are being utilised for temporary posts and fencing. There can be no objection to this if it is understood that such employment must be really only temporary. Eventually the softer cores of such posts will decay and become a mass of loose fibre which will afford an ideal breeding place for the rhinoceros beetle. This objection will not hold good in the case of stems utilised in the construction of buildings where they will be protected from the action of the weather. I would, therefore, suggest that the retention of exposed posts or rails (unless split) for a longer period than twelve months should be prohibited under the pests ordinance.

12. At a meeting of some of the representative planters of the district —held on the 10th instant—I ascertained that several of them would be willing to take up contracts for the disposal of the fallen trees. I am informed that a census of such trees on the European-owned estates has already been submitted to Government, and I think that this may be accepted. In dealing with native properties, the fallen trees would be counted on each place before clearing operations were commenced, and returns submitted together with the claims. To secure the proper burial of the parts, the holes should be left uncovered—after the logs have been placed in position—for inspection by the responsible person.

13. I am informed that there may be some difficulty in obtaining the necessary labour in some of the more southern areas, owing to the occurrence of a second paddy crop and to work on new chenas; but it is not thought that this would interfere with the comparatively lighter work of the destruction of the tops. The disposal of the older stems may be deferred to a more convenient time, as their presence does not constitute any imminent danger.

14. It is probable that these two works will have to be kept distinct and contracted for separately. The earlier operations (the disposal of the upper parts) will represent only about one quarter of the labour.—I have, etc,

(Signed) E. E. Green, Government Entomologist.

A COCONUT PEST.

NEW GENUS AND SPECIES.

At a meeting of the Linnean Society, held on November 25th, 1903, as recorded in *Nature* of January 21st, 1904, a description was read by Mr. David Sharp, F.R.S., of a new genus and species of Coleoptera (Fam. Hispidae) from New Britain. The generic name Brontispa, n. gen. Chrysomelidarum (Hispides, group Cryptonychides), is proposed for this insect, which has of late done much damage in coconut plantations. *Tropical Agriculturist.*

RAVAGES OF RATS AND BATS IN COCONUT TREES

(From Annual Report of the Jamaica Public Gardens and Plantations for the year ended 30th September, 1884, by D. Morris, M.A., F.L.S. *Director)*

Numerous letters have been addressed to me on this subject; and, in addition to this, I estimated that at the Palisadoes Plantation under my charge during the late drought, the losses caused by rats amongst coconut trees amounted to nearly £100 per annum.

Dr. Ferguson of Port Maria reports the destruction caused by rats on his extensive coconut walks as "immense;" and the subject has necessarily occupied his attention for some time: while numerous other correspondents speak in similar terms.

The question of protecting coconut trees from the attacks of rats is therefore a matter of considerable importance, and with the view of contributing something towards this end, I have lately been in communication with coconut planters in different parts of the island, and from the replies received I select one or two, which, as the result of practical experience, will no doubt commend themselves to careful consideration. The first of these replies is from Mr. Joseph Shearer, Vale Royal, Duncans P.O., and is as follows:—

"I got out in 1882, 1,000 sheets galvanized iron 36 inches by 12 inches; they stood me with cost and charges £35. 14s.; and 1,000 tin sheets of the same size, the cost of which was £28 7s. 10d. Although dearer at first, the zinc sheets are preferable, as near the sea the tin sheets soon become rusted. The rats were so bad in the coconut walks where I used these sheets that I reckoned they paid their cost fully the first year. In putting them on I nailed them flat to the trees with two or three sheathing nails in each. If the coconut trees are very close together a rat can go from one to other across the limbs, and great care should be observed that there are no ladders near by, such as a dry limb hanging on the ground, or a mangrove twig, &c,, because if there be any such the rat will get up the tree independently of using the trunk, and the zinc or tin sheets would be of no use. It is useful if you cannot isolate all the trees, at least to isolate clumps. Care must be taken, too, to dislodge the rats from the top before putting on the tin sheets. The best thing I have found for this is sandwiches of bread and phosphoric paste, deposited among the roots and fronds."

Mr. John Clark, Haughton Court, Lucia, writes:—

The zinc sheets to protect coconut trees from rats have been tried here with good results: the rats that live in the trees must first of all be driven out of the trees or poisoned; the sheets must then be nailed round the tree, simply flat against the stem, low enough in the case of short trees, so that the rats cannot spring from the trunk below the sheet on to a limb that may be hanging down near the trunk, which they have been known to do. Rats have been seen attempting to pass over the sheets and falling.

"The sheets are zinc 42 inches by 12 inches, and apparently 1-32 inch thick, and cost about 8d. each in London. The sheets last no time and are not to be thought of. The nails for putting them on are ordered as 5dy. galvanized shingling nails.

It is very probable that Mr. Shearer's and Mr. Clark's plans which require only galvanized iron (not tin) sheets 36 inches by 12 inches and fastened perpendicularly on the tree by means of a couple of sheathing nails will commend itself for general adoption. These sheets cost, it will be noticed, delivered on the estate, at the rate of £35 14s. per thousand. This is a large sum to expend at once on coconut trees, but the bands are

required only for bearing trees, and I quite agree with Mr. Shearer that where the depredations by rats are really bad, the sheets will pay for themselves during the first year. With regard to the preceding remarks it is to be noticed that the rat which commits such damage in coconut trees is the black species, much smaller than the ordinary brown rat of the cane-fields. It is a splendid climber, and as it builds its nest in trees, it is beyond the reach of the mungoose, which is a very indifferent climber. As I have before remarked,* it is only in the open, where cultivation is carefully kept up, and the rats have no special shelter or trees to climb, that the mungoose is a successful rat-killer."

In St. Thomas-in-the-East Mr. James Harrison informs me that he suffers principally in his coconut walks not from rats of any species, but from frugiverous bats (called by the negroes "rat bats," probably, as suggested by Goose, to distinguish them from butterflies to which they give the name of bats). Mr. Harrison finds the best plan to keep down the ravages of the bats "is to shoot them in the day-time whilst hanging in clusters on the trees."

* See "The Mungoose on Sugar Estates in the West Indies," by D. Morris, M.A., F.L.S. Jamaica, 1882.

CULTIVATION OF THE COCONUT PALM.

LECTURE BY WILLIAM JARDINE.

The cultivation of the Coconut Palm is now so universal in all tropical countries that it is next to impossible to discover its original habitat, and there is no authentic account as to when the first coconuts were drifted to the shores of Ceylon. Those who wish for information on this head, and are curious as to the traditions concerning the Coconut Palm, will find it all set forth in the introductory portion of Ferguson's "Coconut Planters' Manual." So far as Ceylon is concerned, the reliable information available points to the Dutch as the people who really began the systematic planting and cultivation of the Palm; and once planted along the seaboard it has been regularly maintained by the dwellers on the land, and has so spread over all the lowcountry, that it is estimated there are at present more than 850,000 acres under the product. The old idea that it would not thrive far from the influence of the sea breeze is exploded, as it grows well all over the lowcountry, where the soil and rainfall are suitable, and even in sheltered valleys at an elevation of 2,000 feet, as in the town of Badulla. We must also give up the poetic fancy that the coconut tree stretches out towards the sea because it loves the briny breeze. The truth is, that the tree is a lover of light, and will bend in any direction to reach it; and as there is no obstruction on the sea shore it naturally bends in that direction, and would do the same if the open space were inland. So sensitive is it to shade of the lightest that it instinctively bends away from it, and instances may be seen where the tree has grown almost horizontally till outside the influences of the shade, before it assumed its upward growth. So exceedingly useful is the coconut tree to man, that one might well believe the Hindoo tradition that it was one of the three palms (Coconut, Palmyra, and Date) sent from the abode of the gods as a gift to humanity; and certainly it was a gift worthy even of the gods, for in the regions in which the palms grow none are so useful or so great a blessing. For the success of a Coconut Plantation the first essential is the right kind of soil; that secured, all else is easy and success assured; that missed, leads to constant trouble, increased expense, and often to failure and loss. It is marvellous how men will go on planting lands utterly unfit, though they have constantly before their eyes the failures of others on like soils. If a census could be taken of the acreage of all bad lands planted, which never have paid and never can pay, it would be scarcely credited. When land unsuited for the successful growth of coconuts has unfortunately been purchased, and even gone as far as to be cleared, the cheapest thing for the purchaser is to let it revert to jungle. The loss of the purchase money would be as nothing compared to the constant drain should he decide to cultivate it.

Description of Lands.—The best soil is of course the alluvial deposit on the banks of rivers, where the land is periodically flooded for a few days; fortunate, indeed, is the possessor of such land. The next best is a deep sandy loam, and 75 per cent. of sand is not too much. On such land the trees grow rapidly and come into bearing early and respond readily to manuring. After this comes a dark chocolate loam, either alone or mixed with quartz or large stones; or a brown soil, also mixed with quartz and stones. These soils, though they may be rich, are, owing to their greater tenacity, not so good for the growth of coconuts, as the trees are slower in growth and take perhaps 12 to 15 years to come into good bearing. Avoid,

as you would your worst enemy, cabook, clay, and clay-gravel soils, for they can never make successful or paying estates. Provided there is sufficient natural drainage, the flatter the land the better. Moderately steep land, if of good soil, is not to be despised, though the cost of all works will be slightly enhanced.

Rainfall.—From 60 to 80 inches a year, well distributed, is what suits the coconut tree best, though it will thrive and bear well with 50 inches on deep free soil, where the roots can travel easily in search of water. Less than 50 inches is perhaps hardly sufficient even on the most suitable soils. It has been said that a rainfall of 100 inches and over sends the tree to leaf and diminishes fruit production. I have not found this so. I know lands receiving up to 160 inches a year which compare well with those receiving only 80. If the soil is good, the extra rainfall does not seem to do harm.

Nurseries.—Where any large extent of lands is to be planted it is not possible to get nuts from selected trees for sowing in a nursery, though this might be done for raising plants for supplies. When selecting from a heap fully ripe nuts should be chosen, the water in which gives a metallic ring when shaken; they should be of medium size, and as smooth and globular as they can be got, as such nuts have generally thin husks and are borne on a short fruit-stalk, and the trees are good bearers. The site for a nursery should be level and not far from water, as the nuts must be liberally watered during dry weather. Cut a trench say 4 feet wide and 8 inches deep; remove all the soil and put in the nuts touching each other, with the stalk end upwards; put in soil and fill in all interstices, ramming in the soil with a stick; water liberally and then put in more soil, leaving only two inches of the top of the nut exposed. I have found this method the most successful. A great deal has been written as to the best position in which to lay down nuts in a nursery. My observation is that it makes very little difference whether placed with the eye end upwards, on the side, or the eye end slightly elevated; they seem to grow well in all positions, and I have read of a man sowing them with the eye end downwards, with what object or with what success I never heard!

Lining.—The base lines should be laid down with a lining instrument as bad lining remains as long as the estate lasts, a witness to the carelessness of the Superintendent. All distances, from 24 by 24 feet to 30 by 30 feet apart have their advocates; I think 26 by 26 feet apart a good distance; the trees, except on the richest soils, have ample room to grow, and there is no unnecessary loss of space. I have not found that trees planted 30 by 30 feet apart bear any more nuts than those planted 26 by 26 feet; and the loss of 16 trees an acre is a serious matter; and this becomes very apparent when, in manuring, there only 48 trees per acre to expect extra crop from, instead of 64 trees. All planters with any knowledge of the habits of the coconut tree never plant nearer than 24 by 24 feet, but too many of the ignorant villagers plant so close that it is impossible for the trees to bear till they are about 30 years old, when they are able, through the pliability of the stems, to sway out in various directions in search of light. This is one of the things the Ceylon Agricultural Association should give its attention to. In the interest of the people a law should be passed forbidding any one to plant coconut trees nearer than 24 by 24 feet apart; and I would even go further and prohibit their being planted under jacks, mangoes, bread-fruit, &c. The triangular method of planting, by which 90 trees can be got into an acre instead of 70 will, I have no doubt, recommend itself to the goiya, who has an insatiable desire to cram into an acre as many plants as he thinks he can get to grow, regardless as to whether they will bear. To me, one of the greatest recommendations of planting in squares is the extra space between every four trees which admits of more light and sun getting to the ground; a coconut tree can hardly have too much sun and light.

Holing.—Three feet cube should be the standard, a cubic yard every way.

Planting.—Where plants have been raised by laying the nuts on their sides, fill the hole with 18 inches of good soil and put the nut on the surface, pressing it into the soil for about one inch steadying the plant with a stick driven into the side of the hole and tying the stem to it. This will keep the eye or sprout free from contact with the soil, where it would be liable to the attacks of the white ant; when the plant is well-rooted fill in to cover the nut. Where plants have been raised in a nursery, with the eye end up, fill the hole two-thirds, and when planting bury the nut to within one inch of the surface of the soil in the hole. In both cases there will remain about a foot of the hole to be gradually filled in by weeding and wash. It is not uncommon to see plants put at the bottom of a three-foot hole, and where the soil is at all hard, the plants when 6 or 7 years old may have a poorly developed stem and the hole be still two feet deep! This only shows what a hardy plant the coconut is, and what unkind treatment it will survive. There are some soils so retentive of moisture, where the water percolates so slowly, that the least depression retains it for weeks, even with a deep drain within a few feet of it. In such a case the only way plants can be raised is by filling the holes right to the surface, and when putting in the plants, burying the nut and four inches of the stem and filling in the soil again to the surface, so that no water can possibly lodge; in this way they grow well. Drains should be cut where found necessary. I am doubtful if it is advisable to drain and plant in really swampy land and old paddy fields; the cost is great to do it thoroughly, and the results doubtful, in my opinion.

Treatment of Plants for the first Five Years.—The practices are many, from permitting the jungle to grow up for a few years and then cutting it down, to cleanweeding the whole surface. The latter is rare except where grown with cocoa or tea. The accepted method is to allow the grass to grow, keeping down weeds and jungle growth, and keeping a radius of from three to four feet round the plants clean-weeded. I think if in the second year this radius were increased to six feet, it would bring on the plants much faster. I have in my mind's eye several patches up to ten acres, which were kept clean-weeded from the time of planting till the fifth year; now that the trees are ten to fifteen years old they show a growth of quite five years over the others planted at the same time, but having only a radius of three to four feet kept clean round each plant; they also came into bearing four to five years before the others. I should mention that the ground was not exposed to the full force of the sun, as cocoa in one instance and Liberian coffee in others were grown for four years. If catch crops like cotton or manihot were grown with the coconuts for four years, necessitating the ground being kept clean, I am convinced it would pay well to do it.

Ploughing.—Where the soil is light and free, ploughing could be done with benefit in alternate years, after the trees have attained their eighth year; but where soils are stiff—and they are in the majority in some districts—we have neither the ploughs nor the cattle capable of doing the work effectually. The only other way to loosen the soil is to, say once in three years, dig it over about six inches deep with mamoties, burying all grass and weeds in the process: and where the soil is deficient in it, scattering broadcast about a ton of freshly-slaked lime per acre. If at the same time, the seeds of some nitrogen collecting plants were sown, it would materially lessen the cost of the work, as so much nitrogen would be added to the soil when the plants were cut down and buried. When a small steam roller, with diggers attached, is placed upon the market it will be a boon to Coconut Planters.

Propping.—This is an absolutely necessary work, from the time the tree begins to bear till the 15th or 20th year, according to the nature of the soil. Each bunch needing it is propped up with a forked stick finely

pointed: the forked position is inserted between the nuts till it catches the fruit-stalk. It is then *slightly* raised, so that the weight is partly lifted from the fruit stalk, and the sharp point inserted into the stem of the tree, the weight of the bunch keeping it in position. Why it should be necessary to support the fruit of the coconut, in its early years, in this way, I am unable to say; but it seems to indicate a weakness, due perhaps to something lacking in our soils. Can any of our numerous agricultural chemists say if there is any chemical that can be added to our manures, capable of toughening the fruit-stalk? Where jungle is scarce propping is rather costly.

Manuring.—Ceylon soils, as a rule, are poor, and to rest satisfied with the returns nature gives, is, in the case of Coconuts, bad policy. If we want heavy crops we must put into the soil the manures necessary to produce them. When should I begin to manure? So soon as you see that your plants need it. If there is a child or an animal suffering from inanition you do not say, Oh! You are too young to be fed up, it may do you harm, and it would be wrong to accustom you to nourishing diet; (this is practically the argument of those who say you should not manure young coconut trees); but you at once treat the child or animal in a rational way and give it the food suited to its condition. So should you do to your plants. Some want assistance earlier than others; and when a person can afford to do it he should begin manuring before his trees show by scanty heads of leaves and reduced crops that they are lacking food. Manure half the estate each year, for I know of no manures—except coarse bone dust—which will last unexhausted longer than two years, and on no account should the trees be allowed to fall into a poorer condition than that in which they were maintained by the manure. There are many Agricultural Chemists now in Ceylon, so there can be no difficulty in ascertaining the right manures to apply. Without doubt cattle manure is the best, but much of that is not available, as pasture outside the estate is rarely to be had, and although the passing of herbage through the intestines of an animal makes it more readily available as food for plants, the grazing of cattle on an estate, and concentrating the droppings to one part, is after all only "robbing Peter to pay Paul." It adds nothing to the soil, but tends rather to exhaust it the sooner. Many persons with the means have not the courage to spend money on artificial manures, fearing that their money may be lost. This timidity arises from ignorance, for those who have used artificial manures know that, when the proper manures are used and judiciously applied, they always give remunerative returns. Again, ignorance makes many impatient and disheartened; they apply manure and expect to see results in crop within a year, forgetting, or not being aware, that it takes quite six months before artificial manure becomes to any extent available to the tree, and that it takes a year from the setting of a nut to its ripening, also that on poor lands the first application is almost all appropriated for the building up of the constitution of the tree, and that it is not till after the second application that results in crop are seen. Others object "if we begin to manure we must continue it"; that certainly you must, and if the money invested in manure yields 25 to 50 per cent. I fancy most persons would desire to continue it! Various nitrogen-collecting plants, through the praiseworthy efforts of the Royal Botanical Gardens' staff, are now being grown experimentally, and no doubt we shall soon have reliable information as to cost and results. It is necessary to remind owners that manuring does not only increase crops, but prolongs the life of the trees for probably from 20 to 30 years?

Enemies of the Coconut Plant:—White Ants. These are not very destructive except on old lands where no jungle has grown for many years; where they have decaying timber and roots to feed upon they rarely do much harm to plants. Many remedies have been proposed, but I have found the following effective:—Place half a quart of salt under the nut

of the plant and keep it in its place by a stake driven into the ground. tying the stem of the plant to the stake; no earth should come in contact with the nut, and after the plant is thoroughly rooted earth may be gradually filled in; mild showery weather should be chosen for this. A very old and experienced hand recommends dipping each nut into a thick strong mixture of salt and cow dung; a pinch of corrosive sublimate added would be an improvement.

Wild Pigs.—Where these are numerous they are very destructive and capable of destroying almost every plant in a clearing within a week of planting out. The only remedy in such a case is six months before putting out the palms, to plant up the clearing with manihots and sweet potatoes; the pigs being fond of these will confine their attention mainly to them, and do the minimum of harm to the coconut plants. Where not so numerous a reward of Rs. 5 and the carcase will send a good many Shikaris on their tracks.

Porcupines.—There are very wary and destructive animals. The following plan, for their destruction, was tried with marked success on an estate near Ambalangoda. Take a few coconuts that have germinated sufficiently to largely develop the fuz-ball inside the nut: split the nuts with a clean stroke of a sharp axe, and into the fuz-ball mix about two tea-spoonfuls of "rough on rats"; close the halves together again and tie loosely with a piece of jungle creeper. Leave these in the tracks of the animals; so long as there is the least taint of the human hand they will not be touched, but after the animals will feed on the nuts and die. Seventeen were killed in this way within a fortnight. This plan would also suit for the Bandicoot rat.

Cattle are most harmful to young plants, for if badly eaten down by them the plants must be replaced with others, as they will never thrive or grow into good trees. The only protection against cattle is a good fence, and to allow none into the estate till the plants are five years old. Perhaps Mr. Price of Delwita, Kurunegala, might favour the Association with a description of the method he has perfected, by which nearly 2,000 buffaloes are grazed on 1,400 acres of coconut land. A third of the plants are young and ordinarily would be eaten down, and yet scarcely any of them are damaged.

And now I come to the greatest enemy of all, which begins its work when the others enumerated are incapable of doing further harm. I mean the "Kandapanuwa" (*Rhynchophorus ferrugineus*). I do not intend to give a description of this insect, or its ravages, as it is well-known to all Coconut Planters, and has been fully treated by Mr. Francis Beven in the paper recently read by him before the Ceylon Agricultural Board. Anyone wishing for fuller information can find it at page clix, of the Appendix to Ferguson's "Coconut Planters' Manual" in a most instructive and exhaustive paper by the Director of the Royal Botanic Gardens, Singapore. If men were put on to search for beetles from the time the trees have reached their third year up to the eighth, many plants would be saved, as they can be when the attack is detected in time: when far advanced it is best to cut the tree down, kill all the larvæ and pupa and then thoroughly burn all the affected parts. Why the weevil should so seldom attack trees after they are 8 feet high has not yet been satisfactorily explained. The suggested change in the condition of the sap, when the plants are about to blossom, making it more attractive to the weevil does not account for plants four and five years old being attacked, and as this condition of the sap continues all through the time of blossoming and bearing, it is difficult to explain why trees ten to twelve years old are rarely attacked. If, however, the weevil can only deposit her eggs in a crack or wound in the stem or branches, and does not use her ovipositor, this immunity from attack can be explained, as it is rare for the stem to be injured after it attains a height of ten feet.

Mr. Ridley in his paper on "The Destruction of the Coconut Palm by the Beetles" writes, "Possessed of a remarkably long ovipositor, it finds its way to the base of the leaf stalk of the palm, and pushes the eggs as deeply into the body of the tree as it can." A writer in the Encyclopædia Brittanica says the insect makes a hole in the tree with its long rostrum or proboscis, and shoves an egg into the hole as well!! It may be, too, that this red weevil cannot fly very high. The elytra (of weevils) are very hard, and in some cases fused with one another, rendering flight impossible." May this not be the case with our weevil to a limited extent, and as regards upward flight?

The "Rhinocerous" Beetles *(Oryctes Rhinocerous)*.—Wherever I have lived on Coconut Estates in the Northern, North-Western and Western Provinces—I know nothing of the Eastern—I have found this beetle do so little harm beyond frilling some of the leaves, that I have left it strictly alone. It does occasionally and accidentally eat out the heart of a young plant and so kills it, but this occurs so seldom that it is not worth considering. Where these insects are so numerous as to fray every leaf on every plant (as I have seen in parts of the Puttalam district) it may be advisable to spear them; but beyond the unsightliness I have seen no harm done. Do not meddle with the branches of young trees, beyond cutting back the dead ones; let them stay on the tree till they fall off of their own accord. Many plants are exposed to the attacks of the red weevil by the premature removal of the leaf stalks in the desire to make the plants look neat and trim.

Any one desirous of going in for Coconut cultivation would do well to carefully consider my remarks on soils, and also disabuse his mind of the very prevalent falacy—mainly amongst Europeans—that Coconut trees come into bearing in six years. This occurs only on the finest soils, and even then the bulk of the trees are not in bearing till the 8th year. On inferior soils it takes 10, 15 and even 20 years for the trees to bear anything appreciable. The "goiya" who plants his few dozen trees, and does not count the value of his labour, can afford to wait, but not the Capitalist, who invests his money in the hope of quick returns. Under the most favourable conditions the cost of bringing an estate into bearing is considerable; what then must it be when expenditure and compound interest go on accumulating for 15 years. The cost of producing the estate is then far more than it can ever fetch in the market. It has often struck me that the natives of Ceylon pay little or no attention to the item of interest in planting matters, for if they seriously did they would find that in very many cases it would pay them better to lend their money on the mortgage of house or landed property than to open Coconut estates with it. If some of this sounds pessimistic it is due to those who will persist in trying to grow coconuts where nature never intended they should be planted.—*Tropical Agriculturist and Magazine of the C.A.S.*

COCONUTS AND CLAY SOILS.

To the Editor, Tropical Agriculturist & Magazine of the C. A. S.

Poeworedjo, 18th July, 1905.

DEAR SIR,—I am planting coconuts in Java, and am a little confused by advice given by Mr. W. Jardine in your issue of June.

He says: "Avoid as you would your worst enemy clay ground for planting coconut palms." I have on my place one hundred (100) coconut palms now eight years old. These trees are all in bearing and have given a fair crop for two years, and before writing this I have taken some measurements, which are as follows:—Circumference one yard from

ground 4 feet; length of stem to branches 29 feet; circumference of stem at height of 18 feet, 3 feet 5 inches.

I have also counted the fruits on ten palms, and they average 110 nuts to the tree. The branches are about 25 feet long. I consider these palms are very fair, and I am planting 10,000 this year. The soil is a *stiff black clay* formed from the disintegration of lime stone, and is so hard that it cracks in the hot weather. The height from sea-level is 1,000 feet. These trees were planted eight years ago, and for six years were not tended at all. When I took the place over there were all kinds of weeds and grasses growing around them. Surely there must be some kinds of clay that are suitable for coconuts? In travelling around Java I have seen no better trees than mine, although as you know in Java they have soils of all descriptions. I think where there is abundance of lime with the clay, coconuts will grow very well.—Yours sincerely,—A. ALLEN.

SALT IN COCONUT CULTIVATION.

(*To the Editor "Tropical Agriculturist."*)

March 2nd, 1904.

DEAR SIR,—The reasons I have always adduced, for the necessity of salt in coconut cultivation carried on away from the immediate sea-borde, are:—(1) that the original home of the coconut is the sea-shore; (2) that salt has a mechanical and chemical effect on the soil; and (3) that for the above reasons, it is not reasonable to measure the necessity for salt in coconut cultivation by the results of chemical analyses.

It is very gratifying to find a confirmation of my views by a high authority, or, to be more accurate, to find that the views I hold on the subject are in accord with those of a well known agricultural chemist.

In reading "Principles of Agricultural Practice" by Professor Wrightson, I find:—"The parent form of Managelwurzel is a maritime plant, the *Beta Maritima*, which grows wild near the coast, in situations where chlorine, in the form of chloride of sodium, is abundant. It is well-known that, while even in inland districts, some twenty pounds of chloride of sodium per acre is yearly brought down in rainfall nearer the coast, where sea-frets are common a very much larger quantity is yearly poured down over an acre. The Mangelwurzel being a cultivated form of *Beta Maritima*, appears from long usage to require a large quantity of common salt, and the application of this substance increases the yield by many tons an acre, especially on soils of light, loamy character. These cases seem to show that special manures are of use in a manner quite distinct from soil requirements." Again, "Additions of sulphate of potash, sulphate of magnesia and chloride of sodium (common salt) often produce a considerable increase in Mangel, but it is open to the view that the effect is a good deal owing to the common salt, rather than to the magnesia or even the potash,

Will not the Government issue salt for coconut cultivation as an experiment to begin with?—Yours truly, B.

Honolulu, June 15th, 1904.

DEAR SIR,—In the April issue of your paper recently to hand I noticed an inquiry as to the benefit an application of salt has on the growth of coconut trees at an altitude. For the benefit of "B," the party inquiring, I would state that at an altitude of 1,800 feet my coconuts treated with salt were seven feet higher at the end of the second year than those untreated. Salt was applied when they sprouted.—Yours truly.

F. W. THRUM.

CLEAN WEEDING FOR COCONUTS.

A weed has been described as a plant out of place, but the term "clean weeding" signifies not merely the keeping out of objectionable plants from cultivated areas, but also the suppression of grasses and "clovers" which are generally permitted to grow in orchards and locally in coconut gardens, in order to provide a "bite" for cattle.

While such plants of prescribed growth as tea are always clean-weeded, it has hitherto been thought that the sturdy coconut palm is in no way prejudiced -if not actually benefited--by the growth of grass in its neighbourhood

Without going into the *pros* and *cons* of the question, we may state that the experience of some planters seems to support the fact that coconut estates are best kept clean weeded for at least the first four years, so that the roots of the palm may have undisputed possession of the soil and have all the available plant food at their disposal during the "tender years" of the plant, and until it becomes throughly established in the ground through the ramification of its roots.

Trees grown in this way are reported to have an immense advantage over their fellows in grass-covered areas, and we have it on the authority of a planter of acknowledged experience that the maturity of the trees are *caeteris puribus* advanced by quite two years.

It may be advanced that the expenditure on keeping coconut land clean weeded is incommensurate with the advantages to be derived, but this would seem not to be the case, for the cost is reported comparatively small. During the first four years it is said that the total cost for that period should not exceed Rs. 30 per acre, and Re. 1 per acre per annum (or even less) is given as the subsequent cost.

One of the chief advantages claimed for the system of clean weeding is the frequent stirring of the soil, and it is asserted that even if the same benefit is to be secured by periodical ploughing up of land under grass. the relative cost of the latter practice will be considerable.

We are aware that Mr. John Hughes, the veteran Chemist, is in favour of clean-weeding, and mentions that the English fruit grower has also come to believe in the system.

There is one advantage which has not been referred to by those with whom we have spoken on the advantages of clean weeding, and that is the greater immunity which young plants would have from the "poisoned tooth" of cattle, that are as a matter of course allowed to graze over land under grass. In this connection the question may be asked -with clean weeding, what provision is there for the upkeep of estate stock? That is a question we will not set ourselves to answer at present. If it is established that coconuts are immensely benefited at small cost by being clean weeded for at least the first four years of their growth, the system is bound to come into vogue; but there are many practical men who do not approve of the practice and have no doubt good reasons to give. Altogether a discussion on the respective merits of cultivating coconuts on grass covered and clean-weeded land should prove both interesting and profitable.—*Tropical Agriculturist.*

SPRAYING COCONUTS
FOR NUTS FAILING TO SET.

The following is an interesting extract from the report (May, 1904) of the Travelling Instructor of the Jamaica Agricultural Society, with regard to the spraying of coconut trees failing to set their nuts. The spraying materials used are

COPPER SULPHATE AND PARIS GREEN.

"With reference to the disease causing the dropping off of young coconuts, and the death of trees, I beg to report that during the past year I carried out the following experiments :—

On Tuesday, February 3rd, at Content, the property of Mr. John Hudson, near Miles Town, Ramble, I sprayed two trees with Bordeaux mixture, with Paris Green added. I removed all loose, dead material from the trees, and gave them in the presence of Mr. Hudson a most complete and thorough spraying. The note which I make on these trees at the time of spraying is as follows :—

"Leaf growth apparontly fairly healthy. Trees about eight years old, throwing out flower spikes but no nuts "holding." Roots apparently healthy. Very old sugar cane growing on same land, looking very healthy. Avocado Pears also doing well. Bananas also give bunches of 10 up to 14 hands, and look exceedingly healthy. The land is apparently very rich." Since the spraying no nuts have dropped from one tree, and there is no doubt that whatever disease had attacked this tree has been effectually stopped for the time being by the spraying, every female flower now developing a perfect nut. No 2 is not quite so favourably situated as No. 1, as regards free play of light and air, and to this fact I attribute the lack of complete success of the experiment on this tree: still it now has on good nuts, whereas previous to the spraying, it never had one good one. 2nd lot treated at Content, three trees sprayed with

BORDEAUX MIXTURE WITHOUT PARIS GREEN.

Sulphate of Iron applied to roots. Note at time of spraying: "Land common pasture, good slope. Guango and other trees around look healthy. Trees age about 12 years. No. 1 dropping all nuts. No. 2 some nuts. No. 3 holding one or two on bunch, rest dropping off." Of these No. 1 is improving every day; No. 2 holds every nut and has now big bunches of nuts; No. 3 now holds all nuts. Note—No. 2 of the group used to produce false nuts, that is those which did not drop off in the very early stages, simply developed shell with nothing in it; all nuts are now good.

3rd lot treated at Content. Three trees treated by burning off dry trash, "Strainer." Note made at the time:—No. 1 drops all nuts. No. 2 produces nuts with nothing in them. No. 3 produces a nut occasionally. Leaf growth of 1 and 3 healthy, 2 only middling. Trees apparently 15 to 18 years old. Nice fine day and trees blazed well." Nos. 1 and 2 are now commencing to hold nuts; No. 3 is holding well.

At Knockalva, on February 5th, three trees were sprayed with Bordeaux mixture with Paris Green added, and numbered I to IX. On the 7th February applied 2 ounces of sulphate of iron to each of six trees, also burned one tree, but had to stop, as other trees were too wet to burn. On February 9th burned nine more trees, numbered 1 to 10. The burning was done in the same way in each case by merely setting fire to the strainer. Note.—The sprayed trees were marked in Roman numerals, the others in ordinary numerals.

The trees at Knockalva are much clustered up with other vegetation, and the land appears to be very wet, and many of the trees are poor and weakly.

None of the trees sprayed at Knockalva show any improvement except No. IV. which is much improved and holding nuts. This at the time of spraying was a healthier, stronger looking tree, although previous to the spraying it had never developed a nut. Of the burnt trees 2, 3, 5, 6, 7 and 8 are holding nuts much better. 1, 4, 9 and 10 are not improving; when burnt, with the exception of No. 1, they were not looking healthy, 2, 3, 5, were the best trees when burnt.

The trees at Knockalva treated with sulphate of iron were in a better and more open position than the others, but they still look as though they might die at any minute; the treatment has apparently not been of the slighest benefit. I propose to spray these trees at the earliest opportunity.

Six trees treated with salt at Lindo Hill shew no improvement, the salt apparently not having the slightest effect. I propose to spray these also.

RESULT OF THE EXPERIMENTS.

To sum up briefly the result, or rather the present observable effects of the experiments, it would appear that the first thing to observe is the general appearance of the tree, whether healthy or not, health being denoted by a thick stem (not bulbous) fine dark green leaves, and large spathes bearing many female flowers. If trees in this condition fail to bear lots of fine nuts but drop when they are the size of a hen's egg, such trees will, I think, be found to be suffering from the disease attacking the flower spikes; this disease appears to be likely to become virulent at any time, and in that stage it kills the finest trees in a few months. I have seen fine trees attacked and killed in two or three months, that is, they have been bearing as well as it is possible for trees to bear, never a nut dropping, then suddenly nuts begin to drop, and before the last nuts on the tree are more than two-thirds developed, all the other spikes have turned black, and the heart rotted out of the tree. These trees will derive benefit from spraying.

On the other hand, if the trees are suffering from debility, through bad drainage, insufficient aëration of soil, or insufficient plant food, then spraying or other treatment of the top is about as ineffectual as drawing a tooth to relieve gout in a man's big toe. The enfeebled state of health, almost without exception causes non-production of female flowers, and also though probably of less degree in importance, smaller, feeble-looking male flowers. I have not been able to undertake any soil fertilization experiments with a view of finding out anything more exact than that pointed out by the fact that I have very frequently seen trees near kitchens, hogstyes, etc., bearing very heavily, while ten yards off trees of the same age, in many cases planted on the same day, have never borne a nut.

IMPORTANCE OF DRAINAGE.

The young trees also at Bogue which Mr. Edwards drained on my suggestion, although not yet fruiting, show the immense importance of drainage, these trees having lost all traces of the yellow look which they had before draining, and in most of the trees the new leaves are three times as long as those produced before draining. I may remark here that Mr. Earle laughed me to scorn when I suggested that these trees were suffering from defective drainage.

PLANTING TOO THICKLY.

Allowing the trees to be shaded and clustered up by other trees, is about as fatal to a good crop as any disease imaginable, and yet people are still planting at distances so ridiculous that I refrain from mentioning them. Two to three chains is quite close enough, better to be ten feet too far apart than one foot too near.

Trees planted on poor dry, gravelly ridge look about the same as those in underdrained sour land, in each case I presume, if the trees could talk, they would tell the same tale. Too much of what they do not want and too little of what they do want.—(Signed) W. Cradwick.

THE GERMINATION OF THE COCONUT.

By Ivor Etherington.

The seeds of most plants grown as agricultural crops are so small that no attention need be given to the position of the seed in the germinating bed, particularly in the case of minute seeds scattered broadcast or sown by means of a seeddrill. Even with much larger seeds of the planting products of the tropics, such as tea, cacao, and the species of rubber plants, Ceara, Castilloa and Hevea, there is no necessity to take precautions that the seed may lie in any particular way in the soil. However placed, the seeds seem to germinate equally well, and the young seedling plants grow up equally straight and sturdy. The coconut. however, has such a very large seed and the aperture in the kernel, through which the embryo plant has to push its way up through the surrounding husk, is so placed, that the position of the coconut on the seed bed is of some importance in its germination.

If the nut is laid on its side, horizontally, or nearly so, the plumule and radicle grow vertically up and down in a straight line through a minimum of the surrounding husk, and the water in the kernel reaches the germ and keeps it moist during germination. This the native Sinhalese practise from their empiric knowledge.

An extensive series of experiments in the germination of coconuts has lately been brought to a conclusion in Madagascar, and the results have been publisbed by Mons. E. Prudhomme, Director of Agriculture of Madagascar, in his book "Le Cocotier." In order to ascertain what are really the advantages or disadvantages of the different positions which can be given to a nut at the time of sowing, he compares the results given by the germination of five plots of fifty nuts placed in the following five positions:—

(1) Nuts placed vertically, point downwards.
(2) Nuts ,, ,, point upwards.
(3) Nuts placed obliquely, point downwards.
(4) Nuts ,, ,, point upwards.
(5) Nuts placed horizontally.

The point of the nut is understood to be the end opposite the stalk.

The nuts germinated in all five positions, but not with the same facility in every case, and Mons. Prudhomme makes interesting remarks on the result. In position (1) the germ has to make a fairly long passage through the surrounding husk (fibre) before breaking through it, especially in those nuts which are characterised by a great thickness of fibre on the peduncle end of the nut, such as the long shaped green coconut. the Seychelles coconut, and the long pointed "Pondicherry red," and others. In this position the plumule grows quite veritically just to the spot where the stalk of nut is, or just beside it. Germination then takes place under good conditions; besides, in this position the nuts occupy very little room in the first seed bed; but against this it can be argued that it furnishes plants less able to resist wind and not holding in their places so well when planted out in the field. "However that may be, I have seen this method employed on a large scale. in the north-west of Madagascar, by a planter who has assured me that it is very satisfactory." I cannot say much, continues the writer in the French, for the 2nd position, (nut vertically, point upwards) which seems altogether illogical, because the future stem is obliged to curve on itself and to follow round the wall of the nut proper to the surface of the enveloping fibre. In this case the germinating point first shows itself on the side of the coconut, downwards from the point. The issue of the plumule is in this case much

slower: this is easily understood on account of the deformation undergone by the young growing stem and the long way it has to grow from the interior of the mesocarp. Nuts placed in this position, according to the trials of the Madagascar Agricultural Department, gave a smaller percentage of successes than any of the other four positions. Further, plants of this sort are transported with difficulty, for there is risk of damaging the young stems in placing them side by side in a box or case, for instance when taking them to the field for planting.

The last three positions have given almost identical results. This is understood since, in the three cases, the growing stem has almost the same passage to make in growing from the kernel. Position No. 3, (nut placed obliquely, point down) which is the most logical as it corresponds with that which the nuts naturally take when they fall to the earth, seems to be the best. The horizontal position, and that in which the part next the peduncle is slightly raised, are according to Mons. Keating, who carried out the experiments, the two best. In the horizontal and oblique positions the germinations seem apparently better than those in which the nuts are placed vertically.

The following table, drawn up by Mons. Keating (Madagascar Agricultural Department) shows the results of his experiments with 250 nuts.

Nut vertical.		Nut oblique.		Nut horizontal.
Point down.	Point up.	Point down.	Point up.	
Germination 66 %	48 %	86 %	72 %	84 %

In Ceylon experience bears out the results of Mons. Prudhomme's experiments. To enquiries made of several coconut planters of long experience in the island, the answer has in nearly every case been the same, viz,, in favour of horizontal planting. Mr. Gerald Nicholas, of the well-known Golua Pokuna estate (whom, by the way, Mons. Prudhomme refers to several times in his work) says: "I am of opinion that the best way to plant seed coconuts in a nursery is to place them horizontally exactly in the actual position they lie on the ground when they fall from the tree. I should say a somewhat oblique position, with the point or stalk end of the nut upwards, would certainly be preferable to planting it vertically." In "*The Tropical Agriculturist*," April, 1895, Mr. Nicholas gave his reasons for objecting to the vertical position as follows:—"When the capsule at the stalk end drops off, it lays bare a depression in the husk directly above the 'eye' of the nut through which the young shoot issues. This depression is comparatively a tender spot in the husk and mositure would enter through it more easily than elsewhere. Therefore, if the nuts be placed vertically with only the spaces between them filled with soil, water would be caught in the depression, and, if superabundant as in the long-continued wet weather, the germ would be endangered." Mr. A. W. Beven, of Horekelly, says:—"I have always advocated their being placed in the same position they occupy when the fall from the tree, *i.e.*, sideways. I argue that the water in the nut is intended by nature to keep the germ supplied with moisture during the period of germination. If placed in this position, the nursery will to a very great extent be independent of watering, as was conclusively proved recently on an estate in the Rajakadalawa district, adjoining Toynbee. During a period of drought no water was available for the nursery within half a mile, yet almost every seed nut grew. Besides, it sometimes becomes necessary to stake the young plant to prevent it floating when the hole becomes filled up with water during heavy rains immediately after planting, or to provent it being blown down. Then the advantage of planting the nuts on their side becomes apparent."

The depth to which the seed nut should be buried has also been the object of experiments at Madagascar. Mons. Prudhomme writes as follows on this point:—

Nuts buried to a depth of 10 centimetres (4 inches) placed in the soil just up to the middle, or sunk just to the level of their tops, have given appreciably the same results. The rate of germination wss almost the same in each of the three cases, and also the percentage of results has only given insignificant differences. It has not been the same in the case of nuts simply placed on the soil; the germination of these was much later and very obviously inferior to that of nuts more or less buried. It is certain that this method is not to be recommended The other three methods gave good results, but as burying to the depths of 10 centimetres, (4 inches) certainly costs much more, and, according to Mons. Keating's observations, requires at least twice as much labour as the others, superficial burying should be recommended. According to Keating, a man, on an average, can place 500 nuts a day in the nursery if they are planted just about level to their tops, and only 200 if buried to a depth of 10 centimetres (4 inches).

Prudhomme recommends the nursery system as practised in Ceylon. He says, the Ceylon planters as a rule place the nuts at first side by side, first in a sheltered shady location, and transplant them to a temporary nursery protected against the sun's rays, 40 to 50 cms. (4 to 5 inches) apart, until the young growths attain to a length of 5 or 6 cms. "This method is certainly the most rational and, in my opinion, most to be recommended, for it allows the shade to be regulated according to the state of development of the young plants and diminishes the space occupied by the nuts. It is possible in these conditions, to reduce to a minimum the work of looking after the young plants." *Tropical Agriculturist and Magazine of the C.A.S.*

CHANGES TAKING PLACE DURING THE RIPENING OF A COCONUT.

The following are probably the changes which a young coconut undergoes before it reaches maturity:—

When the young fruit first appears it consists of a white, astringent tasting, semifibrous mass, which afterwards is destined to form the husk; and of a thin, green outer skin. The nut gradually increases in size, with very little change in composition, until it has grown to be about 3 inches in diameter. It then has a comparatively small, hollow space in the centre which is completely filled with a watery fluid of an astringent, slightly acid taste, and which is much like the juice from a green husk. As this period begins, a rudimentary shell is formed around the inner surface of the nut; at first this is very thin and soft, but slowly it becomes thicker and harder.

Not until the nut has reached its maximum size, with its shell completed, is there any indication of meat or of oily material. When the shell has been formed the milk changes in character, it becomes rather sweet, and a slimy gelatinous mass, having a sweetish taste and containing comparatively little oil begins to deposit on the inside of the former. At first this forms chiefly on the lower half of the nut, but finally it covers the whole inner surface. This pulpy mass soon grows thicker and denser, it increases in oil content at the expense of sugar in the milk, until it assumes the well-known characteristics of ordinary coconut meat. During this last stage the evolution of carbon dioxide which previously was mentioned occurs.

Even in ripe nuts, after they have been picked from the tree, there seems to be a slight continuation of the hardening process in the meat, covering a period of from two to three months, or until the sprout makes its appearance. Then other changes occur, the reverse of those which had taken place previously; the nourishment concentrated and stored up as fat is now transformed into sugars and other bodies capable of being directly assimilated by the young plant. As this process goes on, the embryo or "foot" gradually increases in size until it occupies the whole space inside the nut, and makes use of all the nourishment contained therein for the growth of the young tree.

Therefore, for the largest yield of copra and oil, only thoroughly ripe nuts (the husks of which have begun to turn brown) should be used, and it is often advisable to allow the latter to stand in a dry place for a few weeks before they are opened. The greatest care should be taken to avoid using green nuts, as it is shown by the tables given above that a loss of almost 50 per cent. may thus result.

On the other hand, coconuts should not be stored too long, for in about three months the embryo begins to grow, and even before that time, those nuts which may have been cracked or bruised in gathering, have a tendency to become rancid.—*Philippine Journal of Science.*

COCONUT CULTIVATION IN THE SOUTHERN PROVINCE.

By H. Amarasuriya.

1. Growth on Different Soils Compared.

The soils in which the Coconut thrives best are the flat soils along the sea coast where the Coconut palm finds sufficient natural supplies of salt and lime. It has been noticed that on such favoured soils a mature full-grown tree yields as many as 100 nuts on an average, without any particular attention being paid to it.

Next in importance to the soils on the sea-coast are those on either side of the rivers which overflow their banks periodically during the rainy weather. Coconut trees growing on these river banks also give a considerable yield, but slightly less than those along the sea-coast. However, the farther inland the Coconut is grown the less suitable is the land for its cultivation. Plantations on such lands require a large amount of care and systematic cultivation, except those planted within a radius of 20 or 30 fathoms from the boutiques and huts of villages.

These plantations, though of comparatively small acreage, thrive invariably well. The reason for this exceptional growth is the care which is unconsciouly bestowed on these trees by the occupants of the respective houses; for all refuse, dirt, and sweepings which are carelessly huddled round the trees contain valuable plantfood eagerly absorbed by the Coconut palms.

2. The Mode of Planting and Cultivation Required for Soils in the Interior.

Further inland the soils are not flat but undulating and hilly, with shrubby jungle growth. As only such lands are at present available for further extension in the Southern Province, I would suggest the following for opening and planting new fields:—

The jungle should be felled in December and burnt during the first week in the following February. All the burnt matter having been removed the necessary roads should be cut. It should be borne in mind that these roads are to serve for transport at a subsequent stage, when the estate comes into bearing.

Drains should be cut at a gradient of one in twenty to prevent the rich surface soil from washing down. The Coconut holes are then to be cut to the size of 3 ft. × 3 ft., being 24 feet apart from each other along square lines, giving 75 to the acre. Before the planting season begins in May, the holes should be filled one foot deep with sea-sand, about three basketsful to every hole.

It has been found that sea-sand preserves the young plants from the attacks of white ants and the ravages resulting from dry weather, which immediately follows the planting season. It also helps the young plant to throw out its roots quickly. When the land is fully planted clean weeding should be started and continued monthly for a period of three years. In order to defray a portion of the expenses of weeding, sweet potatoes might be grown.

The plantation during this period should be carefully protected against the attacks of cattle. Three years later, clean weeding might be dispensed with; weeding round the plant only should, however, be continued for another three years. Rooting out jungle growth on the rest of the land ought to be done twice a year: grass however may be left to grow.

At this stage the Black Beetle must be carefully warded off. The trees will then begin to form their trunks, and porcupines will appear as another danger. These are dangers which are familiar to everyone who knows something about Coconut planting, and therefore I need not go further into the mode of their prevention. Assuming that the plantation has eventually attained an age of 10 years, it will be found to have a good percentage of trees in blossom. I may here mention that there are some who believe that a Coconut tree blossoms and begins to bear when it reaches its seventh year. This theory is wrong as a general rule, and it must be borne in mind that such rapid growth is confined only to those trees which are growing on the sea-coast.

3. The Manuring of the Coconut Palm.

The most important question which requires the earnest consideration of the planter when his estate has partly reached the blossoming stage, is the mode of manuring his estate whereby the trees can be made to yield remuneratively without forcing the crops. This work is a very delicate one indeed, and should be taken in hand very cautiously.

Manuring at this stage should not to done indiscriminately. Those trees which are in a vigorous and healthy state, and those with a good development of leaf, must be singled out and left alone; whilst others, which show poor growth, and are on indifferent soil, should be marked out for treatment with the application of the following manure mixture of Messrs. Freudenberg & Co:—

4 lbs. Specially Selected Castor Cake
2 ,, Steamed Bones (Freudenberg's manufacture)
2 ,, Bone Meal
3 ,, Kainit
1 ,, Muriate of Potash

12 lbs.

Cost delivered in Colombo at railway station or into boat
per acre about Rs. 32·14
per ton gross weight Rs. 80·00.

The above mixture, with 24 lbs. of cattle manure added to it, should be applied to every poor tree, so that there would be a total of 36 lbs. of manuring substance. This application would cost 75 cents per tree; but it cannot be estimated how much it would cost per acre, as it is impossible to say here how many trees will be found to need it. When by this treatment the trees are brought to a uniform degree of growth, application of manure, either cattle dung, if procurable, or artificial manure, might be undertaken all round once in two years.

FREUDENBERG & Co.

Hultsdorf - Mills.

MANURE WORKS.

Provided all trees are beyond the reach of cattle, I would suggest another very commendable mode of manuring. Buffaloes or cattle might be tied during the night, one to each tree. The urine and other excrements from these animals contain splendid tree fertilizings properties, and the constant trampling round the tree loosens the soil and makes it porous, thus helping the roots to assimilate the manure quicker.

One animal should be tied to a tree for ten days in succession, and then another tree should be treated similarly. To carry out this system of manuring successfully, 100 head of cattle will be required for a plantation of 100 acres, and it will take two years to give a complete manuring to the whole acreage. If sufficient fodder and grass can be procured easily for a herd of 100 head of cattle, I consider it very advantageous to resort to this mode of manuring.

Green manures, such as "Keppitiya" and Kaduru, if available in large quantities, are also good for application to the Coconut tree. A bundle of 40 lbs. of either of these mixed with burnt coconut husk should be buried round the tree five to six feet from the trunk and 6" deep.

4. Number of Trees and their Yield per Acre.

There are some who recommend planting 30 ft. by 30 ft. as a good distance for coconuts. On exceptionally rich soils this distance is, I believe, a very suitable one; but on hilly lands planting 24 feet apart is better.

An acre planted 24 ft. × 24 ft. will contain 75 trees, and if properly looked after, and cultivated in the manner described above, will safely yield on an average 30 nuts per tree annually, harvested in six crops. The best crops of the year are secured during the months of May and July. There are of course rare instances where Coconut trees are found to yield from 100 to 150 nuts each. Such abnormal yields are however confined to exceptional soils and conditions.

A good many nuts are lost on estates during the dry weather of the months of December, January, February, and March, on account of the young nuts falling off, owing to the tender stems of the undeveloped bunches breaking. This loss can be prevented by applying "supports" to them before the dry weather sets in during the month of December, continuing the operation during January, February, and March, when the year's crop has fairly developed into the nut stage.

5. Results from Manuring Experiments.

I shall now lay down some results obtained from experiments, made on a very small scale, in an altogether hill plot, on Citrus Group Estate, Galle, containing about 1,200 trees. Cattle manure in small quantities was applied to a number of trees which showed indifferent growth in 1901, and again portions were manured with Freudenberg & Co.'s artificial manure No. 5 in 1903. A table is appended comparing the crops harvested during a period of five successive years. Had not the severe drought experienced during the first quarter of 1905 caused the falling off of a considerable number of young nuts, a crop of 40,000 nuts could have been easily plucked during that year.

	1902.	1903.	1904.	1905.	1906.
1. February Crop ...	1,112	3,626	2,008	2,469	2,320
2. April ,, ...	1,181	5,517	3,190	4,112	4,668
3. June ,, ...	2,257	6,784	5,700	8,356	6,985
4. August ,, ...	4,140	6,999	6,473	8,759	9,618
5. October ,, ...	2,340	3,245	4,247	7,036	5,253
6. December ,, ...	1,330	2,418	2,175	2,654	2,970
	12,360	28,589	24,093	33,386	31,814

COCONUT CULTIVATION

IN FEDERATED MALAY STATES.

From the Report of the Inspector, for 1903.

The area under coconuts at the end of 1903 in the Federated Malay States may be estimated approximately at about 77,500 acres made up as follows:—

Perak 39,500 acres, Selangor 13,000, Negri Sembilan 13,000, Pahang. 12,000 Total 77,500 acres.

Selangor.—The trouble from the beetle pest, if not altogether suppressed, is at least thoroughly checked and kept well in hand, and I have no fear of any further serious harm spreading unless the evil break out in Kuala Langat or Bernam districts, where I am short-handed. How easily this may happen was evinced at Golconda Estate, 10th mile Kapar Road, during the autumn of the year. This estate is planted practically entirely with Para rubber; but a portion about 50 acres in extent was intermixed with coconuts and it was decided by the owners to remove the latter. Unfortunately this was done without sufficient precaution being taken to see each tree as cut down was thoroughly destroyed, the consequence being that in a very short space of time the red beetles and grub were simply swarming in the stumps and stems lying about. Some idea of the enormous number may be gathered from the fact that as many as 20,000 beetles and grub were killed in one day, and before the pest could be got rid of, and which was done at considerable expense in about two months' time, over 170,000 of them were collected and destroyed. They spread also to the neighbouring estate known as "Kapar," and several thousands of the beetles were caught in the coconut trees here, but the Manager at once put on several extra hands to deal with the evil, which I am glad to say is now eradicated.

Pahang.—The great trouble practically everywhere, but especially in the holdings on both sides of the Pahang river, comes from squirrels, which are in great numbers and do immense harm. Formerly the natives used to employ the Sakei to destroy them with their "blowpipes," but owners complain they cannot get this done any longer. The matter is, however, receiving my attention.

General.—I find from the experience I have had here that the coconut trees between eight to ten years, or even older, that have been attacked by the beetles, easily become recoverable with ordinary care in a very short space of time; on the other hand, young trees between the age of three and six years require continual and particular attention and always give considerable trouble, and this may also be said of the very old trees, which take even longer to come round. The frayed appearance of the coconut leaves so much seen about is quite as much due to the stag beetle as anything else, and this insect, beyond making this despoilment, does absolutely no harm to the tree as far as its growth and produce are concerned.

The Inspector of Coconuts' Report, 1906.

From the report of the Inspector for 1906, we quote certain passages which show the progress of the coconut industry in the Federated Malay States. The total area under coconuts in the Federated Malay States at the end of 1906 is estimated at 105,000 acres approximately, an increase of 5 per cent. over 1906. This is divided among the four States as below:

Perak	53,395	acres.
Selangor...	19,216	,,
Negri Sembilan	17,196	,,
Pahang	15,193	,,

Of this acreage rather more than one-half is in bearing.

Diseases and Pests.

Among the enemies of coconuts we find reference to the following:— In Kinta, Perak, all the trees in one locality were "attacked by a small caterpillar, simply in thousands, which denuded the coconut leaves and left them in skeleton form. These attacks had the effect of the trees losing their vitality and dropping the fruit before it reached maturity. In all, about 1,000 trees were affected. This happened during the dry weather. Although particular attention was given to the trees and all the rubbish burnt in their immediate vicinity, it appears to have no good effect. As soon, however, as the rains commenced, an improvement set in and the pest gradually disappeared. The trees, which were considerably thrown back, are now recovering, and in 6 months' time will, I think, come into good bearing."

Good Coconuts Destroyed for Rubber.

It is mentioned that in Selangor State a large number of coconut trees are being cut down, especially by Europeans, "to make room for rubber that had been interplanted. I cannot believe that this course was a sound one, especially where there was a fair acreage of coconuts, and the trees either in, or just coming into bearing. . . . To instance a case—130 acres of healthy and well-grown coconuts, just coming into bearing and worth fully \$275 to \$300 per acre, were cut down to make room for some rubber, while the latter had not been planted much over a year. In face of the fact that other land was available on the estate for rubber planting, this was, to my mind, a work of wanton destruction, which I believe. the company may have in course of time good cause to regret."

But the destruction of nearly mature trees has had an immediate harmful effect, Mr. L. C. Brown thinks. In the Klang district he reports a very numerous outbreak of beetles, which "continued for a considerable time, and notwithstanding the strictest supervision it was quite impossible to cope with their raids altogether, or prevent a certain amount of harm being done to the trees." He adds: "This sudden and unusually large swarm of beetles, I am of opinion, was due to some extent to the wholesale destruction of so many trees at a time by the Europeans; as, under these circumstances, even with the greatest precautions, it is almost impossible to prevent the beetles taking some advantage of the debris left lying about before the stems can be properly destroyed."

Temporary damage was done to coconut trees at Golden Hope Estate, Klang, by an outbreak of "nettle grub" Caterpillars, a species of *Thosea*, which quite defoliated trees by feeding on them. The insects disappeared suddenly in about 3 months' time; but the harm done was not serious. There is much else that is interesting in the report, but we regret that Mr. L. C. Brown does not specify whether the coconut beetle he refers to is the Red or the Black.

COCONUTS IN THE SOLOMON ISLANDS.

Sydney, Aug. 24.

Dear Sir,—Even to far away Solomon Islands your valuable periodical has penetrated, as I, these last ten years, have been a subscriber through my Sydney Agent, and I as well as others have obtained many valuable hints from it. Especially does anything concerning coconuts interest us, as this is the only product as yet cultivated to any extent in this group, and we should be pleased to find opinions and experiences from other parts of the tropics on this head a bit more frequently expressed than at present, every one here being practically beginners without previous experience of coconut planting. Especially, I think, is the question of open *versus* close planting, a very important one. Without exception we

here now, on the suggestion of Mr. Woodford, the Resident Commissioner, plant open, viz., 33 feet apart or 40 trees to the acre. This allows the leaves on the fully grown trees, allowing for curvature, just about to touch each other. Even if the yield per acre is no heavier by this planting, (which I believe it is) I consider we have two considerable advantages. One is that the trees will in good soil set flowers before four years old, so the first crop is obtainable in five to six years, while, if planted close, the trees will only straggle into bearing after seven to eight. Also with open planting, the grass when first started will grow luxuriantly, so that a considerably larger amount of cattle will find support, thus providing plenty of manure.

Any young men with coconut-planting in view might do worse than investing in this place, as a more suitable country could hardly be found. Here are no hurricanes, plenty of rain equally distributed during the season, the beetle practically unknown, the best of soil, no rats, porcupines or pigs; so one may practically consider the life of the tree assured when the nut is shifted from the nursery into the ground. Land may be had from the Government on 99 years' lease, at a practically nominal rent, or may be bought right out from the natives, subject to Government's approval. The introduction of labour from the islands to Queensland is now stopped, so a good supply may be depended on in the group, at the rate of 10/-per month, and very good workers they are. Should you find space for these lines in your valuable periodical, and anyone seeing them should wish for further information about the group, I shall be pleased on application to tender any service in my power.—Yours sincerely.

O. SVENSEN, *Solomon Islands.*

[The soil must be very good, for 40 coconut palms per acre to grow so that the branches or leaves touch: in Ceylon it usually requires 75 trees, although a smaller number in some cases is planted.—Ed., *T. A.*]

IN COCOS OR KEELING ISLANDS.

Mr. A. S. Baxendale, of the Federated Malay States Service, who has prepared the Colonial Office report on these islands for 1903, gives some interesting details of palm cultivation in the islands as practised by Mr. William Ross. Seed nuts are taken from any palm of the sea islands species without regard to its age.

Eighty trees are planted to the acre, care being taken to avoid regularity in "lining." The reason for this is that wind does less damage when the trees are not in rows. Another very wise precaution to prevent the palms being uprooted by wind is to plant the seed nuts at the bottom of holes 3 feet deep.

The holes so dug are not filled up by hand seeing that the light sandy soil fills up the hole in course of time. The roots of palms planted in this manner are naturally deeper and better covered than are those of trees grown from seeds embedded in the usual manner, immediately below the surface.

It is stated by Mr. Ross that a series of experiments has proved to him that nuts, which are allowed to fall, contain an average of 10 to 12 per cent. more copra than an equal number of carefully picked nuts.

Though at times the islands have suffered to some extent from the ravages of the coconut beetle, yet men are never employed to capture and kill these pests. The trees which show signs of harbouring beetles are cut down and burnt.

IN THE NEW HEBRIDES.

Coconuts are an important cultivation in the New Hebrides, and in the island of Apia several French companies are working. Already in that small island there are about 8,000 trees planted and extensions are proceeding apace. The method of utilising the land in the young clearings is by growing crops of maize or Indian corn (*Zea mays*); this not only yields some return but is useful for giving a light shade to the young palms. The foliage of the corn could be fed to cattle or made into ensilage we should think, or simply returned to the ground for its manurial properties and to increase the humus. A French writer describes the system of growing the catch crop of corn as follows:—

The land, felled, burnt and cleared, is then lined and holed: spacing is 8 by 8 metres or 9 by 9 metres, according to the lay of the land (about 24 by 24, or 27 by 27 feet). The maize is then sown and, when it is about 50 centimetres (18 inches) high, the germinated nuts are planted out. In this way the light shade of the maize protects the young growth of the coconut from the sun's rays, and assists its growth.

The cultivation of the maize continues for two years: after this time the coconut is robust and of good growth, for it has benefited by the cultivation and can be left to itself.

The same writer refers to a coconut pest in Apia; which he describes as follows:—

"The coconut here is attacked by a coleopter about 4 or 5 millimetres in length; head and thorax red, posterior portion black. It attacks the heart of the young plants, and the leaves in large trees. It pierces the leaves, makes gallaries in the fleshy portion of the leaf and deposits its eggs there, from which are produced white grubs which then go all over the leaves. The green chlorophyll disappears, and the leaves fall; a coconut tree attacked has a grey burnt appearance. These symptoms are produced during the course of a year or two and then disappear; the coconut regains vigour, but its vegetation has been retarded. I have tried nicotine, a wash of soap, oil and petroleum, but I have only partially succeeded."

[This beetle is fully dealt with elsewhere in our "Manual".—COMPILER]

IN THE WEST INDIES.

It may be of some interest to bring to the notice of readers the important position occupied by the coconut industry in two of the West Indian Colonies. The export of coconuts from Jamaica and Trinidad is an industry of considerable standing. In the latter island, moreover, the manufacture of copra has in recent years been extensively taken up. Coconut oil is also largely produced both for an immense local consumption and for export. The acreage under coconuts in Jamaica in 1903 was placed at 14,396; in Trinidad, in 1902, the Warden's returns showed 14,000 acres under coconut cultivation. The number of coconuts exported from Jamaica in the years 1902-3 was over 25½ millions, representing a value of £67,903. This industry suffered severely from the hurricane of 1903, and the trade may be expected to be slower in recovering than that in bananas. A very large number of trees was destroyed, but there has since been a large amount of replanting, showing that confidence is still felt in this staple. There is, in addition to the exports, a large consumption of coconut oil in the island. Neither the oil nor copra, however, figures in the list of exports from Jamaica.

The number of coconuts exported from Trinidad during the last few years has not varied much from 10 millions. In 1895 these represented a value of about £35,000, but, owing to a serious decline in prices, the value

in 1902-3 was only £17,000. Advantage has, however, been taken in Trinidad of new uses found for these nuts. The large estates are now equipped with drying houses by which the nuts can be converted into copra. In the year 1903-4 over 2¼ million pounds of this product were exported. Further, most of the plantations are equipped with hydraulic presses for the expression of coconut oil, the exports of which are rapidly increasing. Trinidad growers have thus a choice of three markets, viz., nuts, copra, and oil. In this way the smaller nuts, unsuitable for shipping whole, can be converted into either copra or oil, according to the relative prices of the two products. A valuable paper on the "Coconut-Industry of Trinidad" was prepared for the last West Indian Agricultural Conference by Mr. William Greig, and is published in the latest issue of the West Indian Bulletin. It is calculated that, in addition to the exports, the local consumption of coconut oil in Trinidad, due principally to the large East Indian population, is about 700,000 gallons. This would represent thirty-five to forty millions of nuts. The exports of nuts, copra, and oil are estimated to account for between thirteen and fourteen millions; it will be seen that the total annual production of nuts in Trinidad may be placed at fifty millions. Experience in Trinidad has shown that, to avoid the heavy costs of transporting the nuts, it is essential that the copra-drying houses and oil extracting machinery be erected where the nuts are grown. For this reason, as has already been mentioned, the principal coconut plantations are equipped with the plant necessary for producing these two products. A copra drying house is similar to that ordinarily used for cacao. In some moist districts artificial heat will be found necessary for drying copra. In manufacturing oil from copra the latter is placed in bags and subjected to a pressure of two tons to the square inch in hydraulic presses. It is estimated that one ton of copra will yield from 153 to 156 gallons of coconut oil.

The residue after the expression of the oil is known as coconut meal. It is a valuable feeding stuff for cattle and horses. In the paper referred to above, Mr. Greig urges that every coconut plantation "should have a simple table, calculated from its cost of production and results, showing the relative values of nuts, copra, and oil, which would serve as a guide in the disposal of its products." Such a table Mr. Greig gives in an earlier paper on this industry, published in "Industrial Trinidad." This shows, for example, that, when nuts are worth $10 per 1,000, the equivalent price of copra is $67·86 per ton, and that of oil 50c. per gallon (after allowing for the value of 5·6 lb. of coconut meal per gallon of oil). It will thus be seen that in Trinidad the coconut industry has been placed in a stable and prosperous condition. Reference to the table of exports of Tobago will show that this industry is also of some considerable value to that island. The value of the nuts, oil, and copra exported to Trinidad in the year 1904-5 was £2,453.—*Agricultural News*, August 26th.

THE SOIL IN COCONUT CULTIVATION.

The subject of the soil in coconut plantations is of considerable importance, and the following article by Monsieur A. Fauchère, in the *Journal D'Agriculture Tropicale* (April 1907), who has had experience with the palm in Madagascar, East Africa, Trinidad, and the West Indies, is of interest. Mons. Fauchère refers to the fine growth of coconuts which is to be seen in sandy soils along the sea coasts of many countries. He puts this down to the presence of organic material and lime in the soil; but there is a further point worth noting. The coconut has a far reaching root system and draws its nourishment from a very large amount of material; its roots penetrate to a depth of 6 feet or more below the surface.

and radiate outward from the base of the trunk to a distance of 9 to 18 feet. And then, as Mr. H. S. Walker, Agricultural Chemist to the Philippine Bureau of Science, remarks: "The nutritive material comes not from the soil in which the trees are actually growing, but from an inexhaustible supply of water, laden with plant food, which is constantly seeping down from the higher ground towards the ocean. This underground water supply would account for the flourishing condition of trees in a sandy soil near the sea, even in times of drought, when individuals further inland in higher, less permeable ground, would be dying from want of water." Extracts from Mons. Fauchère's article are translated as follows:—

THE QUESTION OF SOIL.

All writers agree in recognising in the coconut very marked halophytic tendencies (halophyte, a plant growing in salt marshes or partly in sea water), and many affirm that it prefers brackish soils on the sea-borde to all others. It is indisputable that the neighbourhood of the sea is favourable to it; it is equally certain that sea water has no evil effect on it when in contact with the roots; we have seen in the Antilles coconut trees regularly washed by the sea at high tide which were in a flourishing condition.

However, it seems too much to conclude that it prefers brackish soils. For our own part we have studied it in several countries. Trinidad, Jamaica, Guadeloupe, Seychelles, Zanzibar and Anjouan; in none of these countries did the coconut grow in soils really impregnated with sea water. It is in Trinidad that we have noticed plantations situated at the lowest elevations. In the Cedros district. the plantations are generally on a bank of sand very little elevated above the sea level; it did not seem, however, that this soil was salt, for it also produced fine plantations of sugar cane.

EFFECT OF SALT AND SEA WATER.

Further, the effect of sea salt and sea water on the coconut appears to be much less than is generally considered. We are almost certain that those who give sea salt as manure to their palms are wasting their time and money. At Vohidatra estate and at the Ivoloina experiment station near Tamatave (Madagascar) we have carried out experiments during three consecutive years, which give us authority for stating this.

Young palms have regularly received, at the beginning of each three months, 3 kilos of salt, but no difference was seen between their foliage and that of the control plants. Sea water does not seem to have any marked influence either. During three years, at the Vohidatra coconut estate, 10 trees were watered with sea water every morning; 10 neighbouring palms receiving an equal quantity of fresh water. The 20 palms behaved in absolutely the same manner and seemed only sensible to the regular waterings; in the dry season they were, both lots, much greener than neighbouring non-watered trees.

Formerly, a very wrong opinion concerning the tree was credited in Madagascar. It was currently said that the coconut was not particular, and was satisfied with the poorest of sandy soils.

WHAT IS THE IDEAL COCONUT SOIL.

In reality, although it is able to flourish in soils which are bad for other cultivations—on account of their proximity to the sea—it is a tree that is rather particular on the point of soil. It does not seem possible to indicate the ideal soil which suits it. We have seen it growing and flourishing in very different lands. In Trinidad, the finest plantations are on a bank of sand formed by marine alluvial; in Jamaica in the Port Antonio district, the soil of the coconut estates appears to be of coral origin, as at Zanzibar; in the Seychelles, it seems that the soil where the coco-

nuts are planted near Mahé, is formed by the disintegration of primitive rocks, gneiss and granite; at Anjouan, where the palm flourishes splendidly on the hills along the sea coast, the soil is plainly of volcanic origin. It is difficult, among such different soils, to say which is the best suited to the coconut. Only comparative studies made in the different countries would allow of a settled opinion on the subject. But we may state that in all the countries mentioned above, the coconut proves a profitable cultivation. If the soil that is most suited to the coconut cannot be exactly stated, there are several points on which precise information can be given. It is known that the coconut prefers markedly calcareous soils, and the presence of lime in the ground is a favourable indication of success with the plantations. It must, however, be noted, that it also flourishes in soils of which a chemical analysis only reveals traces of lime.

Heavy lands are not at all suitable; it requires light soils, mellow and deep. Alluvial deposits by rivers flowing from granite hills seem also favourable. We know of several valleys of this nature on the East Coast of Madagascar, where are fine coconut estates yielding in a very satisfactory way. M. Rollot made very interesting observations in this connection during his Journey on the East African Coast. He noticed, in the estuary of the Zambezi, on the island of Sambo of which the soil is alluvial and very rich in black mica, young plantations of coconuts having an extraordinay development. He reports that 4-years-old trees were already bearing several bunches of nuts. Such a result is surprising for in the best situations in Trinidad the coconut only reaches this development in the 7th year after planting.

Soils formed by *débris* of coral mixed with marine algae and the remains of sea creatures, appear also to be favourite ground. It is known that it flourishes admirably in the Pacific atolls. These curious islands are at the most $2\frac{1}{2}$ to 3 metres above the sea level, so that the trees always find in the soil the amount of water necessary to them. This condition, for soils of this nature, seems to be one of the most important factors in success, and it is very probable that if these same coral soils were found greatly elevated above the sea the coconut would not flourish in them.

THE COCONUT IN BARBADOS.

We ourselves made observations during a visit to Barbados which deserve to be recorded here. This British island is indisputably of coral origin and was certainly produced by a marine upheaval. Its soil, it would seem, ought to suit the coconut quite as well as that of the Pacific atolls. The greatest altitude of this island is 70 metres; its width is so little that the sea breezes are felt throughout. One would be inclined to regard conditions there as ideal for the successful growth of the coconut; yet this palm is exceedingly rare at Barbados; we do not recall having seen a single tree in the interior of the island. This observation is much more striking since all the islands of the Antilles possess large numbers of coconuts, ; and in making it one is led to seek the reason why coconuts are so rare at Barbados. This cause does not consist in the dryness of the climate: meteorological tables for the island show for 20 years an average annual rainfall of about 1·60 metres (about 63 inches). This is distributed through every month of the year, there is no dry season so to speak in Barbados.

The paucity of coconuts on this island must therefore be attributed to special conditions of the soil. Indeed, this soil which appears to supply all the qualities of the coral soil of the Pacific atolls, presents two serious faults; it is of little depth and does not retain water at all. The sub soil, which is formed of blocks of coral still in a perfect state of preservation, does not lend itself at all to capillary attraction and cannot in any way provide for the trees the quantity of water which their roots demand. Thus, soils formed of coarse coral debris can only offer the plant the

condition of resting on a shallow sheet of water, in which its roots will find the moisture necessary to them. The same remark seems applicable to sandy soils, such as those which grow the fine coconut plantations in Trinidad. On Constance estate, which we have more especially studied, the water level is found at about 2·50 metres depth.

THE NECESSITY OF HUMUS.

We have read somewhere that want of humus in soils is not an obstacle in coconut cultivation; that is not our opinion. It appears on the contrary that organic matter is an indispensable element, as indeed it is for all plants, and sandy soils which are destitute of it do not lend themselves at all to coconut cultivation. In Trinidad the sandy soils of the coconut plantations contain mixed in their mass much organic debris, as well as a great quantity of shells, the source of lime.

It is needless to emphasise here the very apparent difference which exists between these sandy soils and those of the east cost of Madagascar, on which attempts have been made, rightly or wrongly as it may seem, to establish coconut plantations.

TRINIDAD AND MADAGASCAR SOILS.

The first, those of Trinidad, are hardly comparable to the latter in their great depth. They contain organic detritus, shells, and coral debris mixed in all their mass, everything in a word, reveals in the soils a marine origin and in consequence a great abundance of lime. The organic detritus they contain comes from the slime they receive carried into the sea by the mouths of the Orinoco. The second, those of Madagascar, show on the surface a layer of humus of varying thickness, seldom more than 30 centimetres. This humus is peculiar and much resembles that of the "health soils" characteristic of granite districts of Europe. Below this is noticed a bed of reddish sand showing remarkable uniformity for several metres in depth. This sand contains no trace of organic debris, no shells nor coral. It seems also to be totally devoid of lime.

M. E. Gauthier, in his fine work, "Essay on the Physical Geography of Madagascar," thus expresses himself on the subject of the sandy soils on the east coast littoral. "This soil has not only the peculiarity of being sandy: the proximity of coral banks, perpetually washed by the ocean, induces the conclusion that it contains a fairly high proportion of lime."

Practical remarks we have made above appear to be in contradiction of this opinion of so authoritative a writer. In reality this is not so. There exist two zones of sand on the Madagascar east coast; one very narrow, which stretches the length of the littoral between the lagoon and the sea; the other, much more important, which extends between the lagoon and the marshes, separating the former from the first line of hills. M. Gauthier's observations were perfectly correct, for the first belt of sand; and it seems that our own apply to the second belt.

It may be added that the difference between these two belts is very marked in the vegetation which springs up spontaneously after the land has been cleared.

VOLCANIC AND SANDY SOILS.

Volcanic soil, we have said, can support fine coconut plantations; results obtained at Anjouan and the Comoro Islands authorise this statement. Granitic soils themselves can be very successfully cultivated in certain situations; the excellent results obtained by the Seychelles planters are proof of this. But it is a very common but erroneous opinion to think that the coconut prefers very sandy soil to others. As a matter of fact, the sands which are often found along the coast suit it because they contain organic matter and lime. The fertility of such soil may be known without difficulty by the spontaneous vegetation which grows in

them; if they only produce a sparse, shrubby vegetation in which are found heaths and ferns having a dislike to a limestone soil, it is certain that they do not lend themselves to coconut cultivation. Finally, in every case, it must be remembered that the coconut is a tree which cannot endure swampy land, it must have wholesome soil. To recapitulate: if we try to sum up what we have said above, we find it very difficult to lay down rules for soil conditions which should be sought when it is desired to start a coconut plantation. If it is in a new country, where the coconut does not exist, it seems advisable that preliminary experiments should be only of such a nature as to give precise indications on which one can depend in forming a sound judgment.

Observations made on the spontaneous vegetable growth can only be taken as a guide to a certain degree. It is very evident, except in the case of special soils like those of atolls which carry no vegetation, that a forest vegetation is an indication of fertility. Trinidad planters attach great importance to the presence of forest, even in the case of sandy soils such as we have referred to earlier. For the growing of this tree, more perhaps than for any other cultivation, the choice of soil is of utmost importance. If it is well chosen, if it is very suitable to the palms, these will commence to bear about the 7th to 8th year and will have attained the period of full production in about 12 years. On the contrary, if it does not exactly suit their requirements, the first harvest will not be until the 12th or 14th year, and full production will not be reached until about the 20th year. Further, if the soil is too bad, the plantation will not succeed at all, whatever may be done to it.

We have heard the opinion held that with selected manures plantations can be established on the poorest soils and satisfactory results can be obtained. This is possibly true for annual cultivations; but it is nonsense when referring to plantations of bush or tree plants requiring a long period of time before the first crop yield.

Dehérain has written in his remarkable 'Treatise on Agricultural Chemistry' a phrase which we reproduce here, and we invite all Planters to think over it: "It is very dangerous to enter the struggle with a bad soil, which does not return the advances it receives."

COPRA AND COCONUT OIL IN THE PHILIPPINES.

The forthcoming census report upon the industries of the Philippine Islands contains a monograph dealing with the subject of coconut oil and copra, in which an attempt is made to offset by a conservative statement of facts the rather highly coloured reports that have been sent out from the islands, presumably by promoters, in which capitalists have been invited to invest largely in the business of producing coconut oil on very flattering assurances that the enormous crop of copra produced in the islands can be more profitably turned into oil in the Archipelago than exported to foreign countries in the form of dried meats. Following is an abstract from this interesting report:—

Copra and Coconut Oil.—Until very recent years the demand for the "meat" of the coconut or its product was limited to the uses of soap boilers and confectioners. Within the past decade chemical science has produced from the coconut a series of food products, whose manufacture has revolutionised this industry and placed the business of the manufacturer and of the producer upon a plane of prosperity never before enjoyed. The United States took the initiative with the first recorded commercial factories in 1895. In 1897 the Germans established factories in Mannheim, but it remained for the French to bring the industry to its present per-

fection. The conversion of coconut oil into dietetic compounds was undertaken in 1900 by Messrs. Rocca, Tassy & de Roux, who in that year turned out an average of 25 tons per month. During 1902 their average monthly output exceeded 6,000 tons, and in addition to this, four or five other large factories were working together to meet the world's demand for "vegetaline," "cocoline," and other products with suggestive names belonging to this infant industry.

It was necessary to disguise the earlier products by subjecting them to trituration with milk or cream, but so perfect is the present emulsion that the plain and unadulterated fats now find a ready market as butter. These "butters" have so far found their readiest sale in the tropics. The significance of these great discoveries to the coconut planter cannot be over-estimated, for to none of these purely vegetable fats do the prejudices attach that so long and seriously have handicapped those derived from animal margarin, or margarin in combination with stearic acid, while the low fusion point of pure dairy butters necessarily prohibits their use in the tropics outside of points equipped with refrigerating plants. The field, therefore, is practically without competition, and the question will no longer be that of finding a market, but of procuring annually the millions of tons of copra or oil that this one industry will absorb in the immediate future.

Local Use of the Oil.—Coconut oil was once used extensively in the manufacture of fine candles, and is still occasionally used for this purpose in the Philippines, in combination with the vegetable tallow of a species of stillingia. It is largely consumed in lamps, made of a tumbler or drinking glass, half filled with water, on top of which float a few spoonfuls of oil, into which the wick is plunged. In remote barrios it is still in general use as a street illuminant, and so perfect is its combustion that under a constant flicker it emits little or no smoke. When freshly expressed the oil is an exceptionally good cooking fat, and enters largely into the dietary of the people. The medicinal uses of the oil are various, and in the past it has been strongly advocated for the cure of eczema, burns, as a vermifuge, and even as a substitute for codliver oil in phthisis. Its medicinal virtues are now generally discredited, except as a restorative agent in the loss of hair resulting from debilitating fevers. Its value in this direction may be surmised from the splendid heads of hair possessed by the Filipino women, who generally use the oil as hair dressing.

Manufacture of the Oil.—Coconut oil is derived from the fleshy albumen or meat of the ripe fruit either fresh or dried. The thoroughly dried meat is variously known as copra, coprax and copraz. The exportation of copra is detrimental to the best interests of the planter, tending to enrich the manufacturer and impoverish the grower. The practice, however, is so firmly established that the writer can only record a probably futile protest against its continuance.

The causes which for long time will favour the exportation of copra instead of oil in this archipelago may be briefly stated as follows:—

(1.) An oil milling plant, constructed with due regard to economy of labour and the production of the best quality of oil, would involve an outlay of capital of about $2,500 gold and upward, according to capacity. The production of copra requires the labour of the planters' hands only.

(2.) The oil should be packed in well-made barrels or cans. The first cost of the packages is consequently great, their return from distant ports impracticable, and their sale value in the market of delivery not sufficient to offset the capital thus locked up in an unproductive form. On the other hand, copra may be sold or shipped in boxes, sacks and bales, or it may even be stored in bulk in the ship's hold.

(3.) When land transportation has to be considered, the lack of good roads still further impedes the oilmaker. He cannot change the size and weight of his packages from day to day to meet the varying passability of the trail. On the other hand, packages of copra may be adjusted to meet all emergencies, and the planter can thus take advantage of the market conditions which may be denied to the oilmaker.

(4.) The last and most serious difficulty that the oilmaker encounters is the lack of a market for the press cake that results as a by-product of the manufacture of oil. Its great value as a food for cattle or swine and its secondary value as manure are unknown in this country, and the product is practically neglected. This fact is promptly taken advantage of by the buying agents of foreign manufacturers who can afford to bid in the open market up to the full oil contents value of the copra, knowing that the residue will pay all transportation charges and an ample manufacturer's profit as well. So active are copra buyers in controlling this important branch of the industry that they refuse to buy the press cake at any price, and in some instances they have thereby effected the closure of oil milling.

The process of copra making employed in the Philippines consists in first stripping the ripe fruit of the outer fibrous husk. This is effected by means of a stout, sharp spearhead whose shaft or shank is embedded firmly in the soil to such a depth that the spear point projects above the ground rather less than waist high. The operator then holds the nut in his hands and strikes it upon the spear point, gives it a downward rotary twist, and thus, with apparent ease, quickly removes the husk. An average operator will husk 1,000 nuts per day, and records have been made of as many as 3,000 per day. The work, however, is exceedingly hard and involves great dexterity and wrist strength.

Another man now takes up the nut and strikes it a smart blow in the middle with a bolo, dividing it into two almost equal parts. These parts are spread out and exposed to the sun for a few hours, or such time as may be necessary to cause the fleshy albumen to contract and shrink away for the hard outer shell, so that the meat may be easily detached with the fingers.

Weather permitting, the meat thus secured is sun dried for a day and then subjected to the heat of a slow fire for several hours. In some countries this drying is now effected by hot-air driers, and a very white and valuable product secured; but in the Philippines the universal practice is to spread out the copra upon what may be called a bamboo grill, over a smoky fire made of the shells and husks, just sufficient heat being maintained not to set fire to the bamboo. The halves when dried are broken by hand into still smaller irregular fragments and subjected to one or two days of sun bath. By this time the moisture has been so thoroughly expelled that the copra is now ready to be sacked or baled and stored away for shipment or use.

All modern coconut oil mills are supplied with a decorticator armed with revolving disks that tear or cut through the husk longitudinally, freeing the nut from its outer covering and leaving the latter in the best possible condition for the subsequent extraction of its fibre. This decorticator is fed from a hopper and is made of a size and capacity to husk from 500 to 1,000 nuts per hour.

Rasping and grinding machinery of many patterns and makers, for reducing the meat to a pulp, is used in India, Ceylon and Indo-China, and, although far more expeditious, offers no improvement, so far as concerns the condition into which the meats are reduced, over the method followed in the Philippines. Here the fleshy halves of the meat are held by hand against a rapidly revolving, half spherical, knife blade which

scrapes and shaves the flesh down to a fine degree of comminution. The resulting mass is then macerated in a little hand press, and the milky juice which flows therefrom is collected in receivers placed below. This is now drawn off into boilers and cooked until the clear oil is concentrated upon the surface. The oil is then skimmed off and is ready for market.

The process outlined above is very wasteful. The presses in operation are very inadequate, and it is estimated that not less than 10 per cent. of the oil remains in the press cake. This does not occur when the best hydraulic presses are used. It is true that very heavy pressure carries through much colouring matter not withdrawn by the primitive native mill, and that the oil is consequently darker and sooner undergoes decomposition; but modern mills are now supplied with filtration plants, through which this objection is practically overcome.

These operations in miniature are daily reproduced in thousands of Filipino homes where the hand rasping of the nut, the expression of the milky juice through coarse cloth, its subsequent boiling down in an open pan, and the final skimming off of the oil, are in common practice. Notwithstanding the cheapness of labor, it is only by employing a mill equipped with decorticating, rasping, hydraulic crushing and steam-boiling machinery, and with facilities to convert the residue to feeding or other uses, that one may hopefully enter the field of oil manufacture in these islands in competition with copra buyers.

SPECIAL REPORT ON OILS AND FATS OF CEYLON.

BY LEOPOLD FIELD, F.R.S.E., F.C.S.A., LECTURER AT THE HEALTH EXHIBITION, 1884.

The chief, indeed the only fixed, oil of Ceylon with which English manufacturers are commercially acquainted, is coconut oil. This comes into the British markets as a solid, of nearly the consistence of tallow, liquid coconut oil being understood by those who order it to be the portion expressed from the solid, equivalent to the olein or tallow oil as related to stearine.

It is not necessary to say much about the application of so well-known a substance as coconut oil, except to point out that, in the very able report published by the Ceylon Committee at the Colonial Exhibition, a common error has been made in supposing that coconut stearine is used for "candles." The original composite candles of Price's Company, it is true, were manufactured of coconut stearine, but I believe are almost extinct now. Belmont sperm *may* have been once made of that material, but certainly not for nearly thirty-five years, as Mr. G. Wilson, in 1852, lecturing before the Society of Arts, gives the composition of Belmont sperm candles as hot-pressed *palm* acid.

But Price's Company make their "New Patent Night lights" entirely of pressed coconut oil, and these are superseding the old "Star" and "Childs" night-lights hand over hand, the light, whiteness, and cleanliness of the coconut oil, and the replacement of the greasy paper-case by a glass, quite accounting for the public preference. In soap, also, coconut oil is very largely consumed, though far less in England than on the Continent.

And to this point, perhaps, the preference is to be attributed that is given in the English market to Cochin over Ceylon oil. It does not appear to be generally known at the source of supply, but a glance at the market lists will show that the former rules 5s. to 6s. over the latter. And, indeed, the distinction is no fanciful one, for the writer's experience has shown that the brands *known as Ceylon* here are not suited for fine night light or soap manufacture, on account both of colour and smell. Whether the worst parcels from both countries are labelled Ceylon, and the best Cochin, irrespective of their source, is a question for others to determine. It is well though that this difference of reputation should be pointed out.

Stress may also here be laid on the ease with which a good coconut soap may be made. It is very surprising that the sources of supply are hardly ever prone to manufacture their own produce. Yet, an iron pan and a little fuel with cheap caustic soda, and facilities for tons of soap are there. In a country where, besides coconut other equally valuable sponifiable oils abound, with colouring and scenting materials ready to hand, it is quite remarkable that soaps, far better than the trash which Germany has long poured into England, should not be turned out at a high rate of profit. The writer would guarantee, with the materials alone which the Island could place at his disposal, to turn out soap that should rival some of the leading English brands in all respects of scent and appearance, and with a little foreign assistance, of use as well.

Of the various *oils* which the kindness of the Commissioners placed at his disposal, the writer can give but a cursory account, the quantity being so small, and the composition so entirely unknown. In fact of *none* of them had even the name reached his ears before, though scarcely an oil reaches England but sooner or later passes through his hands.

Margosa Oil.—(sp. gr, 910) has too strong a smell (intensified by saponification) to hope for toilet success. Its medicinal properties should, however, procure it a name, if backed with sufficient authority and introduced under good auspices.

Punai Oil.—This gave an excellent soap, curiously enough of a deep *yellow*, not expected from the dark *green* oil. The disagreeable odour vanished entirely upon saponification. If the price be within range, there should be a future for this oil.

Illupai Oil.—This oil, of an almost pure, white, and in consistence and colour much resembling coconut oil, is decidedly the most valuable of all the new oils examined. It saponifies readily, and gives a fine hard soap. Its adoption will depend solely upon the price.

Kekuna Oil, known as candlenut oil, yields a magnificent, firm, lathering soap. Mixed with one-third *Gingelly* and one-third coconut oil, and saponified with caustic soda, slightly potassiferous, soap is formed second to no *animal fat soap*. A great advantage of vegetable oil soaps is their freedom from *smell*, especially that highly objectionable smell that is evolved some time after saponification from tallow and lard curds, &c.

Castor Oil.—It may here be mentioned that castor oil has of late years been enormously employed, in conjunction with coconut, in the manufacture of cheap transparent soaps. Alcohol being so plentiful in Ceylon, there is scope for making a magnificent soap of this class, especially as castor oil is readily procurable, and *sugar* is very cheap.

Essential Oils.—All the varieties produced in Ceylon are so thoroughly well known that it is superfluous to dwell on them. The suggestion, however, might be made, that other at present non-indigenous scents might be profitably cultivated, and thus relieve the redundancy, the plethora of citronella, lemongrass, and cinnamon. Cinnamon leaf is receiving much attention of late as a fine substitute for cassia, and doubtless will be much used in future.

The spirit, treble distilled from arrack, has a peculiar bouquet, which, in the hands of a skilful perfumer, could be made to blend well with the various finer essential oils, (such as ylang, &c.) afforded by the Island. Eau de Cologne owes its peculiar charm to the presence of œnanthic ether from the grape spirit of the Continent. Why should Ceylon not produce an equally fine perfume from her own spirits and essences?

To conclude. It appears to the writer that the energies and skill of the Ceylon manufacturers should be directed, not so much to the production of more of their present goods, but to the culture of new and favourite products, and the direct conversion of these new materials into commercial wares for the retail consumer.

TESTING OF COCONUT OIL FOR PURITY.

The use of coconut oil for soap making has of late years increased enormously, and hardly in a less degree for the manufacture of alimentary vegetable fats. It is often mixed with less expensive oils, such as cotton-seed, sesame, arachis and even hydrocarbon oils, at the risk of altering its properties and causing serious injury to the industries in which it is used.

Alkaline Saturation.—5 grams of the pure, dry, fatty acids from copra oil require 24·1 c.c. of normal soda, whereas 17·7 c.c. are sufficient to saturate seed oils.

Solubility in Absolute Alcohol.—Neutral copra oil is the only fatty oil which dissolves completely in two volumes of absolute alcohol at a temperature of 32 deg. C., with the exception of castor oil, from which it can readily be distinguished by other characteristics.

Iodine Value.—No other fatty oil possesses such a low iodine value as copra oil, namely, 9 per cent. of iodine. That of other vegetable oils varies between 84 and 105. That is, therefore, a very important distinguishing test.

Sulphuric Acid Saponification.—Maumene's process applied to copra oil (at 17-18 deg.) gives good indications, as the temperature obtained exceeds those of other vegetable oils by 50 deg. It is curious that this most distinctive test is not generally used.

Volatile Acids.—The determination of the volatile acids, soluble and insoluble, also serves as another test for the purity of copra coconut oil.

Nitric Acid Test.—A simple agitation of the oil with an equal volume of nitric acid at 40 deg. gives useful indications. Copra oil remains unaltered when it is pure and clear, but becomes sensibly brown by the addition of 5 per cent. of seed oils.

Sulphuric and nitric acids combined, employed in the proportions indicated by Cailletet for the purity of olive oil, furnish most distinct indications with copra oil. Now, thanks to these means of investigation, the analysis of copra oil has been attended with success and its adulteration has greatly diminished, so that it is usually only practised in small proportions, which consequently are the most difficult to detect. For instance, with an admixture of 5 per cent. of another oil, instead of 24·1 c.c. of soda, for saturating 5 grams of the fatty acids, 23·8 c.c. would be required, but as it is not impossible to meet with a pure oil saturated by only 23·8 c.c., a doubt would exist; nevertheless, the benefit resulting from such a mixture is still considerable, sufficient to tempt the unscrupulous.

The special reactions which characterize certain seed oils, will give, in such small proportions, very faint indications or even none at all when these oils have been subjected to an appropriate chemical treatment. The test for arachis oil will be particulary delicate, the crystallisation of a few milligrams of arachidic acid takes place with difficulty in the whole mass. It may also be remarked that the different operations are inconveniently long and minute when a rapid report is required and is often indispensable; a process, therefore, by which it is proposed to remove these defects, is based on the simultaneous action of phloroglucine and resorcine in an acid medium; the sensitivenesss and certainty of the reaction is diminished if only one of these substances is employed. Both phloroglucine and resorcine have been proposed for testing the purity of olive oil, but the results obtained did not offer any

great certainty, olive oil having a very similar composition to seed oils. and even giving doubtful reactions itself, while old seed oils, or those changed by a preliminary refining, produced no colouration at all. This is not the case with copra oil, because it only contains about one-tenth of non-saturated liquid glycerides, whereas seed oils and olive oil have about nine-tenths, being in consequence much more sensitive to the action of the reagents.

Mode of Operation.—The temperature of the reagents and the oil should be 10-12 deg. C.; the oil should be clear and free from water; if necessary, it should be filtered. Pure 40 deg. nitric acid is required free from nitrous oxides; a freshly opened bottle is best. The phloroglucine and resorcine should be quite pure, of recent preparation, and protected from the warmth and vapours of the laboratory. The saturated solutions should be made the same day, employing perfectly pure ether and benzine. It is needless to add that all apparatus used should be scrupulously clean, Having taken these precautions 4 c.c. of the copra oil are placed in a 15 c.c. graduated tube, and 2 c.c. of the saturated solution of phloroglucine in ether added; when dissolved 2 c.c. of the solution of resorcine in benzine are added. The tube is then immersed in water at about 10 deg. C., care being taken that not the least drop enters the tube; it is then withdrawn and 4 c.c. of nitric acid (40 deg.) added. The whole is then transferred into a clean test tube and violently agitated for five seconds; if no reaction is produced the contents of the tube are well shaken up at intervals. attentively observing the oil all the while.

Copra oil remains perfectly clear and is practically unaltered, negligible traces of impurities give a rose tint, hardly perceptible and rapidly disappearing. The addition of any seed oil, such as arachis, sesame, cottonseed, poppy seed, rape, castor, etc., in the proportion of 5 per cent. and more, produces a bright red colouration, quite characteristic, which remains some seconds. Tallow and the oleonaphthas give the same colourations. Olive oil also produces the reaction, although less perceptibly: the process cannot, therefore, be used for determining its purity. Pure butter and lard are not affected, and consequently the presence of tallow or seed oils can be detected in these bodies by this test, but with less certainty and sensitiveness than in coprah. It is not necessary to take into account the reactions which are subsequently produced under the prolonged action of pure nitric acid. In short, Copra oil can be rapidly tested by this method, which responds to the needs of the numerous industries in which it is used so largely; it is distinct, sensitive and can be applied in a few minutes. The determination of the constants has always agreed with the indications it has given. It is as well to carry out a second test simultaneously in which 5 per cent. of arachis oil has been added to copra oil for comparison.

The action of pure hydrochloric acid and fresh sesame oil:—It is well known that old or altered seed oils do not give the same reactions as the fresh oils. Cottonseed oil which has been heated, for example, does no longer reduce silver nitrate. The process just described preserves the same value in all cases. If the intermixture is made in sensitive proportions the presence of an altered oil in copra oil can be detected by pure hydrochloric acid, after adding fresh sesame oil. Thus a cottonseed oil, insensible to the ordinary reactions, is mixed with the copra oil, and, after ascertaining that the phloroglucine-resorcine reaction has not lost its insensity, fresh sesame oil is added to the same mixture, and the whole shaken up with an equal volume of pure hydrochloric acid. In a few seconds the acid layer acquires a fine characteristic green colour. Old or altered sesame oil, which does not become red by the action of hydrochloric acid in presence of sugar or furfurol, gives a green colouration by the addition of fresh sesame oil and pure hydrochloric acid. Pure, old, or altered copra oil is not sensitive to this reagent.—*Les Corps Gras Industriels.*

DIFFERENT SOILS:
THE KEEPING QUALITIES AND THE CAUSE OF RANCIDITY IN COCONUT OIL.

(SUMMARY.)

SOIL.—In attempting by means of soil analyses to explain why coconut trees growing near the seashore are more prolific than those planted farther inland, it was observed that—

(1) Chemically, there is very little difference in soils from the two localities those from inland regions being, if anything, a little more fertile.

(2) The salt water from the sea has no influence on trees in its vicinity, as only amounts of chlorine so small as to be negligible were found to be present even at the bases of coconut trees which were actually growing on the beach.

(3) The greater porosity of soils near the sea coupled with the fact that they are, as a rule, practically saturated with water at a distance of only a few feet beneath the surface of the ground, is the principal reason why they are more suitable for trees like the coconut, which require an enormous quantity of water for their growth.

(4) Although good coconut soils are apparently almost devoid of fertility, yet, taking into account the character of coconut roots and the large area from which each tree draws nourishment, it can be demonstrated that there exists an ample supply of nutriment, for their growth.

THE NUT; AGE IN REFERENCE TO QUALITY.—(1) The variation among individual nuts is sufficiently great to render exact conclusions from analytical data difficult, but, taking the average of a number of determinations, there appears to be slight increase in the proportion of meat, copra, and oil in nuts which have been stored up to a maximum time of three months after cutting. Beyond this period there is a decided decrease in these constituents. Nuts taken from the same tree show somewhat less individual variation.

(2) Four series of ten nuts each, of varying degrees of ripeness, showed a marked difference in the amount of copra and oil to be obtainable from them, the percentage of the oil in a green nut being only about one-half of that which it is when the nut is fully ripe. This ripening process continues to some extent, on storage, after cutting.

(3) Analyses of coconuts from the some locality, but having husks of different colour, prove that the colour of a nut has very little if any influence on its composition.

(4) The difference between trees near the seashore and those farther inland is solely in the quantity, not in the quality, of nuts which they produce, coconuts from inland regions averaging fully as well as those from the beach. This fact is shown both by analyses and by practical tests on a large scale.

(6) Coconut oil is generally stated to have a great tendency to become rancid, but all the experiments made in this laboratory show that, when once prepared in a pure state, its keeping qualities are equal if not superior to those of most other vegetable fats and oils. This popular fallacy in regard to coconut oil probably arose from the inability or disinclination on the part of most observers to procure pure samples, as the commercial product unquestionably has a high acid value and a bad odour, deteriorates with fair rapidity, this change being greater as a rule the greater the initial acidity of the oil.

(7) Most of the free acid and the accompanying bad odour and taste is produced in the copra itself before the oil has been expressed. The oil from a sample of copra which had been cut into fine pieces and exposed to moist air for one month increased in acidity from 1·5 to 23·3 per cent.

(8) The hydrolysis and subsequent destruction of fat in copra is brought about by moulds (the greater part of which are Aspergilli) acting either alone or in symbiosis with certain bacteria, the condition most favourable to this growth being a moderately high, constant temperature and a water content of from about 9 to 17 per cent. No organisms were found growing on a sample containing 4·76 per cent of moisture and no change in acidity took place. Samples containing from 23 to 50 per cent of water were infested by several species of bacteria which subsisted in the nonfatty portion of the copra, but produced very little free acid from the oil. No moulds were found in these samples.

(7) Ordinarily, commercial copra contains from 9 to 12 per cent of moisture, a very favourable condition for mould growth. The remedy for this rapid deterioration is simply to dry it so that it contains not more than 5 per cent. of moisture, and express the oil as soon as possible, avoiding long storage in a warm, moist atmosphere.

Drying.—By comparing the various methods of copra drying, a hot air apparatus, either rotary or stationary, was found to be the most efficient, It is suggested that a combination of centrifugal with hot air drying might prove of considerable value, provided a market could be obtainable for the by-product "coconut cream." Vacuum drying is not of great value in the desiccation of coconuts for oil-making purposes.

(10) Although a pure coconut oil is not a suitable medium for a growth of micro-organisms, one containing a sufficient amount of nutrient matter and moisture may, under certain conditions, develop a growth of mould which rapidly attacks the oil itself. A sample of pure oil to which had been added 1 per cent. of "latic" and 1 per cent. of water inceased in acidity from 0·10 per cent. to 8·63 per cent. on standing exposed to mould action in an incubator for one week.

The very slight increase in acidity which a pure oil suffers on long standing is probably due to simple hydrolysis by heat and moisture.

(11) Besides the production of free acid by moulds and the decomposition of albumen by bacteria in moist copra and in impure oils, one other factor enters into the deterioration of coconut oil. Many samples on long standing develop a slight but noticeably acrid taste and odour, without any marked increase in acidity. Such oils invariably give a blue colouration wifh Schiff's aldehyde reagent, reduce silver nitrate in Becchi's test for cotton-seed oil and possess the power of liberating iodine from potassium iodide This process is shown to be a direct oxidation by the air and to depend largely upon the amount of surface exposed. Other conditions favouring it are freedom from moisture and impurities, as is shown by the fact that impure commercial oils, or those which have been acted upon by mould, do not, as a rule, respond to tests for peroxide and aldehyde, while the most marked development of these bodies is noticed in the purest oils.

(12) The action of light and air on coconut oil is of relatively little importance in comparison with the great changes produced by mould growth, and it can be prevented in a large degree by keeping oil receptacles as nearly full as possible, so as to reduce the amount of surface exposed.—*Philippine Journal of Science, Vol. 1, No. 2.*

CLASSIFICATION OF COCONUT OIL IN AMERICA.

The U. S. A. Treasury Department recently made an important discovery with regard to the action of the Department of Justice upon a decision of the United States Circuit Court for the district of Oregon with regard to the dutiable classification of so-called coconut oil. The decision referred to held this product to be entitled to free entry, but in promulgating the text of the opinion of the court the Treasury Department announced that the Attorney-General would take an appeal to the United States Circuit Court of Appeals. Customs officials naturally assumed that such an appeal was in fact taken, and that the case was still pending in the upper court, and, therefore, assessed duty on importations of coconut oil at several ports. The Treasury Department, however, was recently informed that, after thorough investigation, the Attorney-General had decided to abandon the case, and it is understood that general instructions will be sent to collectors at all ports to admit this product free of duty.

The case ruled upon by the United States Circuit Court was that of the United States *vs.* the Oriental American Company. The defendant imported 46,912 pounds of refined coconut oil, which was so classified by the customs officers, but which after analysis by the United States chemist at New York was re-classified, under instructions from the Secretary of the Treasury to the Board of General Appraisers, as "Cocoa-butter or cocoa-butterine," under paragraph 282 of the tariff act of 1897. When so re-classified, the merchandise instead of being entitled to free entry became liable to a duty aggregating $1,641·92, for the recovery of which suit was brought by the United States. In deciding this issue the Circuit Court, in a comprehensive decision covering a variety of similar products, said, in part :—

"Cocoa-butter is produced from the beans of the cacao or chocolate tree, the word 'cocoa' used in this connection being a corruption of the word 'cacao.' The importation in question is made from the fleshy part of the coconut, a product of the coco palm. All products made in imitation of cacao or cocoa-butter, and adapted to its use, are classified as cocoa-butterine, and are dutiable.

"It is conceded by the government that the importation in question is refined coconut oil. The reason given for classifying it otherwise is that it is in fact coconut oil deodorized and prepared for edible purposes; that the refining process had rendered it agreeable to the taste and edible, and that it is not placed on the market under the name of coconut oil, but under various names indicating a different product and used from coconut oil; such as 'Mannheim butter,' 'vegetable butter,' etc.

"The refining process which constitutes what is called the 'manufacture of the oil, merely removes from it the impurities due to the manner in which the kernel is handled and dried, and to its partial decay. There is no standard of impurity by which the coconut oil of commerce is known. That oil, for anything that appears to the contrary, may be a pure and edible oil. An edible coconut oil is not a butter because it is edible. Other vegetable oils, like olive oil and cotton-seed oil, are edible, and with butter are used in culinary purposes by Chinamen in the Straits Settlements. It must be assumed that whether an oil is an oil or a butterine does not depend upon the degree of rancidity it has, by which its general culinary use is affected. A product to be dutiable as cocoa-butterine must be useful as a substitute for cocoa-butter. It must be an artificial substitute for cocoa-butter. Such is the holding of the Board of General Appraisers.

"As already appears, cocoa-butter is a product of the bean of the cacao or chocolate tree. The oil from coconuts, to be classed as cocoa-

butterine, must be an imitation of this cacao or cocoa-butter—it must, in other words, be an artificial cocoa butter. The testimony in the case shows a wide difference between the two articles. One of the witnesses, a dealer who has sold coconut oil of the manufacture in controversy for a year and a half, testifies that he never offered it for sale or knew of anyone else offering it as cocoa butterine; that it differs in appearance from cocoabutterine; that there are of the imported butterines and those manufactured here some 12 or 15 different cocoa butterines; that they are all solids, with a melting point of about 90 degrees Fahrenheit, and are usually sold in cakes, wrapped in paper and packed in cases, while the oil in question melts at about 80 degrees completely and becomes a liquid, and is sold in hermetically sealed packages; that the two products differ in color, in texture, and in the use to which they are applied; that cocoa-butterine is sold to confectioners and pharmacists as a substitute for cocoa-butter; that in the pharmaceutical trade the cocoa-butter and butterines are largely used for suppositories; that they are similar in colour, in texture, in the nature of the fracture when broken, and in the degree of melting; that in many cases the odour of the cocoa-butter is attempted to be introduced in the butterines, not always successfully, but that they are put up in the same manner, packed in the same weight of packages, and bear, as nearly as an imitation may bear, all the characteristics of cocoa-butter; that they are readily recognized by everyone in the trade; that confectioners refuse to buy the oil in question because its low melting point makes it entirely unsuitable as a substitute for cocoa-butter. The testimony of the confectioners is that the importation in question is not used as a substitute for cocoa-butter; that any sweet, clean fat can be used to a limited extent in thinning chocolate; that most fats dissolve at a very low degree, while cocoa-butter, because it melts at a higher degree, is more suitable for thinning chocolate, "so the chocolate won't dissolve and spread" and that in the confectioner's business cocoa-butter is chiefly used for this purpose. Some of these witnesses testified that they had used the coconut oil in question, but it was not successful; that it was no more suitable for their use than lard or cottonseed oil. From the testimony in the case it appears that this coconut oil is used chiefly for soap making, and that more than three-fourths of the importation on account of which this action is brought was purchased by one manufacturer for such use.

"From these facts, I conclude that the merchandise in question is not an imitation of nor a substitute for coconut butter, and that it is not dutiable under the tariff act."—*Oil Reporter, New York.*

[In connection with this interesting decision of the U.S.A. Circuit Court of Appeal we have to remark that it is to be regretted that a difference in spelling of these products is not adhered to in America. A certain amount of confusion is always liable to arise when the commercial products of the two plants *Theobroma Cacao* and *Cocos nucifera* are both spelled "cocoa." Cocoa is a correct spelling of cacao products; "coco" the spelling for the coconut palm and its products. We have altered to the correct spelling in above and everywhere in this Manual.—Ed. *T. A. & Mag. C. A. S.*[

COCONUT OIL BUTTER.

Dr. Denner, a German chemist, has been experimenting with coconut oil, and finds that it makes a very satisfactory article of butter. It contains 7 per cent. of soluble acids, namely, butyric acid and capric or decylic acid, which gives the butter a pleasant aroma and savour, making it taste something like a hazelnut. This butter will keep 15 or 20 days before showing any acid reaction, and sustains many of the tests of true butter, for which it is a better substitute that oleomargarine, and can be produced much more cheaply.—*Tropical Agriculturist.*

REPORT ON A SAMPLE OF COCONUT "WATER" FROM CEYLON.

BY PROFESSOR WYNDHAM R. DUNSTAN, M.A., F.R.S.

A sample of this material was sent to the Imperial Institute in 1904 by the Secretary of the Ceylon Committee for the St. Louis Exhibition, and is referred to in letters No. 190B. dated the 8th August, 1904, and No. 210B. dated the 23rd October, 1904.

It was stated in the first of these letters that the Commissioner for Ceylon at the St. Louis Exhibition had reported that a firm in St. Louis was making experiments with a view to the extraction of sugar from the "liquid matter" (water) of the coconut, and it was suggested that it might be worth while to conduct similar experiments at the Imperial Institute with the view of ascertaining whether sugar could be profitably extracted from this material in Ceylon, where it is at present a waste product in the process of preparing copra.

DESCRIPTION OF SAMPLES.

The sample of the "water" measured two gallons and consisted of a thin, slightly opalescent liquid which had a strong odour of chloroform, the latter having been added to prevent fermentation during transit.

CHEMICAL EXAMINATION.

The composition of the water was determined in the Scientific and Technical Department of the Imperial Institute with following results:

Saccharine constituents :	
Mannitol	1·8 per cent (approximately).
Cane Sugar	0·1 ,, ,,
Glucose	0·9 ,, ,,
Acid constituents :	
Volatile acid (calculated as acetic acid)	0·07 ,, ,,
Non-volatile acid (calculated as tartaric acid)	0·41 ,, ,,
Mineral matter :	
(Ash)	0·50 ,, ,,
Water	96·00 ,, ,,

There are a number of previous analyses of coconut "water" on record, with which the foregoing results may be compared. According to J. Lepine ("All about Coconut Planting," A. M. and J. Ferguson, Colombo, 3rd Edition, 1904), Bizio has stated that the "water" and the kernel of tho coconut "contain no sugar but mannitol." Lepine does not give a reference to Bizio's paper in which this statement occurs, and consequently it has been impossible to verify it. Two papers by Bizio on the subject of the composition of coconut "water" are published in the *Ann. Sci. Lomb. Veneto* (iii, 1833, pp. 1-16 and pp. 107-120,) but in these there is no reference to mannitol, the only sweet costituent found being a substance, which is named "Glycina," and the reactions of this are not identical with those of mannitol. According to Lepine (*loc. cit.*) the sugar present in both the kernel and the water of the coconut is ordinary cane-sugar.

More recently Van Slyke (*American Chemical Journal*, 1891, 13, pp. 130-131) has found 3·9 per cent of glucose and a trace of cane sugar in the "water" of unripe coconuts, and 4·42 per cent of cane sugar and a trace of glucose in the "water" of ripe nuts, whence it would appear that during the ripening process, the glucose in the coconut "water" is largely converted into cane sugar. Van Slyke found no mannitol in the "water" from either ripe or unripe nuts.

As the results obtained in the examination of the present sample of Ceylon coconut "water" were not in harmony with those of Van Slyke, it was thought advisable to examine a sample of "water" from ripe coconuts as imported into the United Kingdom.

This gave the following results :

Saccharine constituents :	
Cane Sugar	2·6 per cent.
Glucose	0·5 ,, ,,
Mannitol	nil
Other organic matter	1·1 ,, ,,
Mineral constituents :	
(Ash)	0·5 ,, ,,
Water	95·3 ,, ,,

These results agree fairly well with those recorded by Van Slyke for the "water" of ripe coconuts. The present sample of water from Ceylon coconuts appears therefore to be abnormal in containing mannitol in place of almost the whole of the glucose and cane sugar usually present. It would be interesting to know whether this replacement of glucose and cane sugar by mannitol constantly occurs in nuts grown in Ceylon, or whether it is characteristic of a particular variety of nut.

It is worth notice that mannitol is very closely related to glucose, and that it is possible that the presence of mannitol in this sample of "water" may be due to a change similar in character to the "mannitol fermentation," which occasionally takes place in wine, whereby the sugars normally present in the wine are partially converted into mannitol.

GENERAL CONCLUSIONS AND RECOMMENDATIONS.

It is clear from the foregoing results that it would be impossible to manufacture sugar from coconut "water" as represented by this sample, since it contains only 0·1 per cent of cane sugar. Further, it is highly improbable that sugar could be manufacturd at a profit from coconut "water" even when this contains the whole of its saccharine contents in the form of cane sugar. Van Slyke found in the richest samplè of coconut "water" he examined 4·43 per cent of cake sugar which was associated with 3·15 per cent of non-saccharine organic matter and 1·06 per cent of ash. The crude juice expressed from the sugar cane contains as a rule nearly 20 per cent of cane sugar, and not more than 0·5 per cent of non-saccharine organic matter and about 0·25 per cent of ash

Coconut "water" therefore contains at the most only about one-fifth the amount of sugar present in the juice of the sugar cane, and as the cost of extraction would be much greater in the former case, there seems little likelihood that the "water" could be successfully utilised as a raw material for sugar manufacture, even though it is at present a waste product in Ceylon.

PLANTING IN SANDY SOILS.

SOME SUITABLE PLANTS FOR COCONUT DISTRICTS.

The question as to what to grow on soils consisting of pure sand depends to some extent on the conditions and environment of the place to be planted. If it is near or on the sea-shore and washed by the sea, or sometimes covered with salt spray, certain plants will live ; but if it is inland and without the percentage of salt, the exposure to wind and spray and other conditions which obtain at the sea-shore, then other species and rather more of them will grow.

SEA SHORE OR SAND-BANK PLANTING.

For planting a sea-shore sand-bank the following plants are of value, chiefly from their breeding properties and not because of any feeding or other direct economic value. If a good covering of a vegetation is obtained, it is generally possible later to introduce plants which are of better value from a feeding or other economic point of view.

SPINIFEX SQUANOSUS L.—"water pink" Maharawana-rewula S.—This grass is grown on the Madras coast for its sand-binding qualities—as the Sinhalese name implies "Great Bund of Rawana or Rama." It is common on the shores round the Island and its seed can be easily collected.

IPOMEA BILOBA FORSK.—Mudu-bin-Tamburu S.—This is a creeping plant of the order Convolvulaceæl, with brilliant purplish-rose flowers. It is, perhaps, the commonest plant on the sea shore sand along the south and west coast,

SCAEVOLA KOENIGII—Vahl. is a largish bush sometimes ten feet high with big light green leaves and yellowish-white flowers common on the South-west coast.

MORINDA CITRIFOLIA L.—Ahu S.—a small tree.

BARRINGTONIA RACEMOSA FORSK Medilla S.—A smallish tree with long drooping branches common on the shores of back-waters and lakes.

PANDANUS ODORATISSIMUS L.—Mudu-keyiya S. Talai T,—The "Secret pine" this grows some 15 or 20 feet high and spreads in all directions sending stout aeril roots down from its branches. It is the most vigorous plant that can be used for permanently recovering sand-banks.

INLAND SANDY SOILS.

For an inland sandy, almost purely sandy soil the following grasses will be of use :—

ANDROPOGON ACICULATUS RETZ, Tuttiri S. Lovegrass, a ubiquitous grass that gives an excellent cover to the soil and a good feed for cattle.

CODON DACTYLON PERS. Arugam-pillu T.—A useful fodder plant from which hay can be made. In very sandy soil, however, like other grasses, it has a stunted growth and produces less foliage.

PANICUM REPENS L, Etôrá S.—This is, perhaps, the best fodder grass for poor sandy soils; it grows almost as well in dry sandy soil as in wetter and more marshy places.

In addition to these DESMODIUM TRIFLORUM D.C.—A creeping clover Hin-undu-piyali S—though not rising more than about ½ to 1 inch above the ground, makes a good "bottom grass" and binds the soil together.

THE METHOD TO ADOPT.

The simplest way to go to work in covering sandy soil with plants for food and to make a green covering is to carefully examine places (near at hand) of similar conditions as to soil, &c., and to select the plants thereon which seem fittest for the purpose. The seed of these can be collected by children or the plants themselves can be taken and dibbled in.

THE SENSITIVE PLANT.

MIMOSA PUDICA L. the sensitive plant—has a high value from the fact that it is an excellent fixer of free nitrogen. having on its roots large quantities of bacterial nodules. The thorns on the plant are, of course, a great draw back. but if these can be put up with, the plant which is so easy to grow would no doubt soon show its helpful properties to coconuts or other cultivated plants among which it grows if dug in from time to time.

J. B. CARRUTHERS

RUBBER AND COCONUTS.

NOT INTER-PLANTED WIDELY IN CEYLON.

As the result of enquiries made of representative planters in a number of districts, we do not find that there are many clearings where the coconut palm and Para rubber are being tried together. In the case of the Matale district, where we can recall a considerable area under the coconut palm, a good many years ago, we can learn of no clearings at present with coconuts and rubber. The same report comes from the far South of the Udagama and Galle districts—although tea is, of course, freely interplanted there with rubber. It is different in the Kurunegala district where there are several experiments made with the palm and the new product, and we expect full particulars shortly; but we learn that in one particular instance, where a trial has been given over a small acreage, it has not been a success. The palms have not prospered and the rubber trees are only "middling"—although both were planted nine years ago. Accordingly, the managing proprietor has decided to cut out the coconut palms during the present year in order to see the effect on the rubber. Would it not be wise to try the experiment on half-an-acre both ways—cut out the palms on one half-acre and the Rubber trees on the other—and watch the result before deciding to do more? From the Kelani Valley we have an interesting report from which we venture to quote as follows:—

"There is little or no area of mixed coconut and rubber planting hereabouts. Avissawela, on Atherfield, old coconuts were cut out (they did not pay there and were not encouraging) and rubber (Para) planted 14 × 14 or so right through the area, and have grown most successfully. On Clara estate in the same district, a large number of acres of the tea have been planted through with coconuts, and to my mind, except on the low-lying lands, are not of much account; through this again Para has been planted, perhaps 15 × 15 and carrying 180—200 plants to the acre, taking road-side trees."

Farther on, from the centre of the Ratnapura planting division, we have the following expression of opinion by a practical Manager:—

"This is not a coconut producing district to any extent, and there are no clearings of coconuts and rubber that I know of. There is no reason why both products should not be planted, in which case the fencing absolutely necessary for the protection of the rubber, would serve for the protection of coconuts—so wickedly neglected at present. Presuming coconuts to be planted 25′ × 25′, I consider Para rubber might be planted 1 between 2 coconuts *on the line*, and 1 between 4 coconuts between the lines. In my opinion, generally speaking in the lowcountry, it is false economy to try to overcrop our poor land in the total absence of any pretence to a proper system of cultivation—I refer particularly to Sinhalese methods."

Finally, there comes an interesting report from the Batticaloa district under date May 19th last:—

"As regards coconuts, well-known natives have, together with Europeans, opened about 600 acres of new land for coconuts during 1906. The cyclone is responsible for over 400,000 palms absolutely lost. As regards the area added to existing small native gardens, it is quite impossible to give a fair idea. As regards rubber the only clearing I know of is that of Messrs. Doudney & Crosbie Roles at Vakaneri tank. They have a grant of 60 acres, half of which is under cotton. The trees are Para and two years old. I am not certain, but I think the distance between the trees is 12′ by 12′. Rubber under irrigation might do here, but otherwise this district is certainly not a place for rubber—though I have a good many

Ceara trees in different places. The quantity of the latex is disappointing. I suppose this is due to the sandy soil and shortness of rainfall. If I had the money, I would go in for rubber near Maha Oya and Rugam tank, where magnificent jungle stands. Those places have ever so much more rain than Battlcaloa and its neighbourhood; and, what is more, the rain is more evently distributed over the hot season The late Mr. Fielder grew almost everything on his experimental garden near Maha Oya—(now abandoned because a flood swept his place away). He had: Coconuts, Pepper, Vanilla, African Oil Palms, Dates, Pineapples, Cacao, etc., and all grew magnificently. The only trouble would be scarcity of labour in those parts; but that difficulty could be overcome,"

With these returns as to the facts, conditions and prospects in different divisions of the country, in respect of the planting of the Coconut palms and Rubber trees together, we must content ourselves for the present. Further information will be given and commented on, as it comes in.—*Ceylon Observer.*

HON. MR. JOHN TURNER'S VIEWS.

The *Pinang Gazette and Straits Chronicle*, 26th June, in reprinting above says. "As the matter is one of great importance to those interested in planting in the Straits and the F. M. S., we brought above article from the *Ceylon Observer* to the notice of the Hon. Mr. John Turner and asked him for his opinion on it. In reply to our queries, Mr. Turner said that he had been watching matters in this direction for some years past and that two years ago he took a series of photographs of an estate where rubber was interplanted with coconuts, with a healthy catch-crop of tapioca as well. The coconuts were then in bearing and the rubber was being tapped. A few days ago he revisited the same estate and found that while both the rubber and the coconuts looked thoroughly healthy as regards the growth of the trees, and the rubber was yielding well, the coconuts had practically failed to produce nuts. The reason for this appears to be the rubber soon overtops and shades the coconuts, thus depriving them of the light necessary to produce the fruit. It would apppear that the coconut fruit needs a great deal of light and that explains the provision of Nature in having the leaves of the coconut tree open as they are. Mr. Turner added that his experience of cutting down rubber trees showed that the Para tree will stand being reduced in height so that it does not overtop the coconuts. If the two crops are planted in each case thirty by thirty, 48 of each to the acre, and the rubber kept considerably lower than the coconuts, both will probably give a satisfactory yield in suitable soil, the coconuts probably requiring manuring with salt, etc. In the finest coconut plantations in the neighbourhood about Penang, where the trees have reached a considerable height, you can observe mangosteen trees and other crops planted between them and doing well, but in this case the mangosteens were planted long after the coconuts and had not been allowed to overtop them. Mr. Turner said that the natural conclusion he arrived at from his own experience and observations was that it would be a suicidal policy to cut down good coconut trees to make room for rubber without trying experiments to see if the two would not grow well together."

CULTIVATION OF THE OCONUT.

A NOTE ON THE PAPERS DEALING WITH THE COCONUT PALM IN THE JANUARY ISSUE OF "THE PHILIPPINE JOURNAL OF SCIENCE."

BY C. DRIEBERG.

These papers on the Coconut palm are essentially studies in biology, and the details of minute experiments which are described are not such as will appeal to the mind of the practical planter. For these reasons I do not recommend that the papers should be quoted locally, at least

in their entirety. There are, however, a few practical facts and deductions which I give below with a view to their being brought to the notice of coconut cultivators:—

It may almost be said that the physical character of soil is of greater importance than the chemical composition. The coconut requires a porous soil with water within easy reach of it (though, of course, not in a stagnant condition); in the absence of water the tree protects itself against injurious desiccation by a partial suspension of vitality, with a consequently reduced yield of crop. Given such a condition as is above referred to, the tree will thrive even though according to chemical analysis there is apparently not sufficient fertility in the soil to enable it to do so.

But it must be borne in mind that the roots of the coconut draw nutriment from a depth of at least 2 metres (6½ feet), and a distance round the tree of from 3½ to the 6½ metres (say an average of 5 metres, 16½ feet nearly). They, therefore, come in contact with an enormous mass of soil material, and appropriate the available plant food scattered (very sparsely it may be) through it. It thus happens that even in poor sandy soils, which are, however, porous and provided with water, there is quite enough nourishment for the tree.

Much of the food available to palms growing along the seashore is traceable to the "wash"—chiefly underground—which comes from the land side and flows seaward. Such underground wash keeps the plants found along the seaboard in a flourishing condition, while in inland and higher situations, where the soil is less permeable, plants suffer from a lack of moisture and therefore of nourishment.

Irrigation is thus to be recommended for the latter description of soils in dry seasons; and the use of manures, particularly those furnishing mineral food, are likely to be repaid in an increased yield.

To put the matter shortly, on a loose soil where water is at hand, the roots travel about freely and find plant food which is then absorbed in the form of very dilute solutions. In higher and drier land where the soil is of a firmer texture the tree is less able to forage for itself owing to soil resistance and paucity of water. The proportion of mineral food taken up may be said to be proportional to the amount of water absorbed.

It will thus be seen that it would be a manifest advantage to increase the transpiration in the plant, and so increase the absorption of water and mineral food.

This may be done in two ways—

(1) by increasing the amount of water at the disposal of the roots.

(2) by improving the conditions for evaporation through the leaves. Judicious irrigation will bring about the first, but the soil must not be allowed to become "logged."

For the second there should be ample sunlight and "wind." Provided the roots are not too dry, the more the tree is exposed to these forces the better for it. *To this end avoid close planting.* It may be generally stated that the further apart the trees are planted the better they will thrive. Certainly up to 15 metres (50 feet nearly) any increase will appreciably increase the yield. It is the interlacing of roots and leaves, and the competition among trees for air and water that reduces their yield. The best ordinary distance is 9 metres (30 feet nearly). It is only in exposed situations, or where intensive cultivation can be economically carried on that this distance may be reduced.

The reason why trees thrive along the seaboard is attributable to the fact that their roots are able to stand the action of concentrated solutions (e.g., sea water) and the leaves delight in sunlight and wind. As with other plants it is possible to create artificial conditions as favourable, if not more so, to crop production. But the conditions referred to above must be provided even in the richest soils for the best results, viz., sunlight, water, and wind; for a lack of light, a restricted supply of water, and a still atmosphere, are unfavourable to the coconut.

In selecting nuts, they should be taken from a tree in which the productive power is great in proportion to its opportunities, *i.e.*, one that bears a proportionately larger number of nuts than its neighbours. It is a mistake to select nuts from trees which are equally prolific in a given area. Heredity (individual character) rather than environment should be looked at in this matter.

Though we would not expect to find it so, both chlorine and common salt may be said, from the insignificant quantities in which they are found, to be negligible elements in the food of the palm. According to analytical results it is found that there is a gradual increase in the proportion of meat (kernel), copra, and oil (with a decrease of milk, indicating that the meat becomes firmer, loses water and gains oil) as the nut increases in age up to three months of storing; *i.e.*, when they are beginning to sprout. In nuts kept for six months, though the meat is practically the same, there is a marked decrease in the proportion of copra and oil, due to decomposition or other causes. Thus both in very fresh and in over-ripe nuts there is a considerable deficiency in oil.

In planting in the nursery the practice in the Philippines appears to be to cut a small section of the husk off the top of the nut to afford more easy egress for the sprout.

As a protection against wild pig a pit 4 or 5 feet deep is dug and the nuts planted at the bottom.

"Grill-dried" copra is not so liable to be attacked by insects and moulds, though it is considered inferior owing to its dark colour and smoky flavour.—*Tropical Agriculturist & Magazine of the C.A.S.*

COCOS NUCIFERA.

(From the *Treasury of Botany.*)

The well-known coconut tree is the type of this genus of palms, to which, in addition, about a dozen other species belong. They mostly form tall graceful trees, and the majority of them are natives of the tropical regions of America; one only, the common coconut, being found in Asia or Africa. Their leaves are very large and pinnate. Their flowers are of separate sexes produced on the same spike, both having a calyx, consisting of three sepals, and a corolla of three petals, the males containing six stamens united at the base, and the females an egg shaped ovary, with a short style and three stigmas, and sometimes six barren stamens. The fruit is either elliptical, or egg-shaped and three-sided, and contains a single seed enclosed in a hard bony shell, which has three round holes at its base, and is surrounded by a dry fibrous husk.

The Coconut Palm, *C. nucifera*, is now so extensively cultivated throughout the tropics, that it is impossible to ascertain its native country: there can be no doubt, however, that it is indigenous to some part of Asia, probably Southern India. It exists in vast quantities on the Malabar and Coromandel coasts, and adjacent islands, growing in the greatest

luxuriance upon sandy or rocky sea-shores, and evidently preferring the vicinity of the sea, although it sometimes occurs a considerable distance inland. It is also common in Africa, America and the West Indies. Its extensive geographical distribution is accounted for by the fact of the tree growing in such close proximity to the sea, that the ripe fruits, falling on the beach, are washed away by the waves, and afterwards cast upon some far-distant shores, where they readily vegetate. It is in this way that the coral islands of the Indian Ocean have become covered with these palms. It is also worthly of remark that the triangular form of the fruit facilitates its progress through the waves.

The Coconut Palm has a cylindrical trunk, sometimes as much as two feet in diameter, and rising to the height of sixty or one hundred feet, its outside being marked with scars, indicating the places from which leaves have fallen away. It is surmounted by a crown of gracefully curved feathery or pinnate leaves, each of which is from eighteen to twenty feet in length, and composed of strong, tough, central foot-stalk, with numerous narrow long and sharp-pointed leaflets arranged along both sides of it, given the entire leaf the appearance of a gigantic feather: the base of the stalk spreads out so as to clasp the stem, and is surrounded by a kind of fibrous net-work of a light-brown colour. The flowers are arranged on branching spikes five or six feet long, and enclosed in a strong tough pointed sheath (spathe), which splits open on the under-side, displaying the delicately white but inconspicuous flowers. They are succeeded by branches containing from twelve to twenty fruits, each of which is about a foot long by six or eight inches wide of a three-sided form, and covered by a thick fibrous rind or husk, enclosing a single seed contained in a hard shell, which is what is commonly called the Coconut in this country.

The uses of this palm are so numerous that space will only allow us to give a brief outline of them. In this country we know comparatively little of its value. It is true that we are indebted to it for several very useful articles, such as coconut fibre, coconut oil, and the coconuts themselves; but they are all articles that we might contrive to do without. In tropical countries, however, such as Southern India and the adjacent islands, the case is very different; there the Coconut palm furnishes the chief necessaries of life, and its culture and the preparation of its various products afford employment to a large part of the population. Every part of the tree is put to some useful purpose. The outside rind or husk of the fruit yields the fibre from which the well-known coconut matting is manufactured. In order to obtain it, the husks are soaked in salt water for six or twelve months, when the fibre is easily separated by beating, and is made up into a coarse kind of yarn called *coir*. In 1858 we imported 81,138 cwt. of this fibre. Besides its use for matting, it is extensively employed in the manufacture of cordage, being greatly valued for ships cables, and although these cables are rough to handle and not so neat-looking as those made of hemp, their greater elasticity renders them superior for some purposes. Other articles of minor importance are now made of this fibre, such as clothes, and other brushes, brooms, hats, &c., and when cured and dyed it is used for stuffing cushions, mattresses &c., as a substitute for horse-hair,

The next important product of the fruit is the oil procured by boiling and pressing the white kernel of the nut (albumen). It is liquid at the ordinary temperature in tropical countries, and while fresh is used in cookery: but in this country it is semi-solid and has generally a somewhat rancid smell and taste. By pressure it is separated into two parts—one, called stearine, is solid, and is used in the manufacture of stearine candles; the other being liquid is burned in lamps. As an article of food the kernel is of great importance to the inhabitants of the tropics. In the Laccadives it forms the chief food, each person consuming four nuts per day, and the

fluid commonly called milk, which it contains, affords them an agreeable beverage. While young they yield a delicious substance resembling blanc mange. The hard shells of the nut are made into spoons, drinking cups, lamps, &c.; reduced to charcoal and pulverised they afford an excellent tooth-powder, and very good lamp-black is made from them.

Amongst other products of this palm may be mentioned 'toddy' which is obtained by the same process as that described under *Borassus flabelliformis.* When fermented it is intoxicating, and strong arrack is distilled from it, besides which it yields vinegar and 'jaggery' or sugar.

The leaves are greatly used for thatching houses, for plating into mats, baskets, hats, and similar articles; and from strips of the hard foot-stalk very neat combs for the hair are made. The unexpanded leaves cut out of the heart of the tree are used in the same way that we use cabbages. The brown fibrous network from the base of the leaves is substituted for sieves, and also made into fishermen's garments, and the extremely hard wood obtained from the outer portion of the trunk is used in the construction of both houses and their furniture. In this country, under the name of Porcupine wood, it is made into work-boxes, and other fancy articles. Finally, we may mention that the natives attribute various medicinal qualities to this palm. The flowers they employ as an astrigent, the roots as a febrifuge, the milk in opthalmia, &c.

Few of the other species of this genus present particular features of interest. *C. butyracea,* a native of New Grenada, yields toddy, but the manner of extracting it is very different to the process employed in Eastern countries. The tree is cut down, and a long cavity excavated in its trunk near the top; in three days' time this cavity is found to be full of toddy, which, it must be borne in mind, is the sap of the tree. Its seeds yield a semi-solid oil. *C. coromata,* a small Brazilian species not more than thirty feet high, has a pithy substance in the interior of its stem which is used as food; seeds also yield oil. [A.S.]

THE COCONUT PALM

(*From the Dictionary of the Economic Products of India, Published in 1889.*)

COCOS, *Linn.; Gen. Pl. III.,* 945.

COCOS NUCIFERA, *Linn.; Brandis, For. Fl.,* 556; PALMÆ.

THE COCONUT PALM; THE COIR OR COCONUT FIBRE; PORCUPINE WOOD; COCOSER, *Fr.*; COCOSNUSS, KAIR, *Germ.*

VERN.—*Nárel, náriyal, náriel, náríyel, náriyal-ka-pér,* HIND.; *Nárikel, náriyal, dáb, nárakel,* BENG.; *Nariel, naríyéla, náríera, nàliyer, náryal, jháda, náryal,* GUJ.; *Maar, naril, mahad, narel, naral-cha-jhádá, már, naural,* BOMB.; *Narela, nárula, náralmád, mád, máda, mahad, varala, narel, naráli-cha jháda, naral, mar, tenginmar,* (the juice-yielding form in Kanara), MAR.; *Nárél-ká-jhár, nárél,* DUK.; *Tenna, tenga, tennan-chedi, tenna-maram, téngáy, taynga,* TAM.; *Nari kadam, ten-káia, kobbari, goburri-koya, ten kaya, kobri chullú, kobbari chettu, ten-káya-chettu, erra-bondala, gujju-narekadam,* TEL.; *Thenpinna, kinghenna, tengina, tenginá-gidá, tenginá-káyi, tengina chippu, tenginay amne, tenginararu,* KAN.; *Tenga, ténn-maram, tenna, nur, kalapa, nyor, kalambir,* MALA.; *Nur,* MYSORE; *Nari-kela, nári-kera, nári-keli, langalin,* SANS.; *Fadhirdah, shajratun-nárjil, shajratul-jouze-hindí, nárjil, jouze-hindí.* ARAB.; *Darakhte-nárgil, darakhte-bándinj, nárgil badinj,* (*narjible* in Ainslie) PERS.; *Pol, pol-gass pol-gahá, pol-nawasi, tambili.* SING.; *Ong, ung, ung bin, ón, onsí, ontí, ondi,* BURM.; *Kalapa,* JAVA.

DRY KERNEL, COPRA (KOPRA) OR COPPERAH.—*Khóprà*, HIND.: *Khópra*,: GUJ.: *Khóprá, khópré-kí-battí*, DUK.: *Kobbaruit-téngày*. TAM.: *Kobbera, kobbera-ténkáya*. TEL.; *Kóppara*, MALA.; *Kobari, kobbari*, KAN.

OIL, COCONUT OIL.—*Khópárc-ka-tél, narigal-ká-tél. naril-ká-tél*, HIND., DUK.; *Nárikél-tail, náriyal-tél*, BENG.; *Nâryal-nu-tél*, GUJ.; *Náralicha-tìla, naral-tela, kóbra, cha-téla*, MAR.; *Téngá-yenney, taynga-nunay, tengái-yenne*, TAM.; *Tenkáya-núne, tenkáia núnay*, TEL.; *Ténna-énna, minak, kalapá, minak-nur, nur-minak, kalambir, kalapa minak*, MALA.; *Tengina-yanne. cobri*, KAN.; *Nárikela-tailam*, SANS.; *Dho-nun-narjíl, dhonul-jouze-hindí (jowz-hind* in Ainslie), ARAB.; *Róghane-nárgìl ròghane-bándinj*, PERS.; *Pol-tél*, SING.; *On-sí*. BURM.; *Cay-dua*, COCHIN-CHINESE.

WATER=*Yelnir-ka-pani*, DUK.; *Yella nir*, TAM.; *Yella-niru*, TEL.

TODDY.—*Nárélí*, HIND.; *Nárél-kí-séndì, narillie*, DUK.; *Téngá-kallu, tennan-kallu, tennang-kallú*, TAM.; *Tenkáya-kallu, tenkala*, TEL.; *Nargilie, nargilli*, ARAB.; *Táriye-nârgil*, PERS.

FIBRE.—*Coir?* (See first paragraph of chapter on Coir), HIND.; *Tennam nar*, TAM.; *Tenkaia nar*, TEL.

COCONUT CABBAGE.—*Tennam kurtu*, TAM.; *Tenkaia gurtu*, TEL.; *Naril-ka-krute*, ARAB.

COTTON OR TOMENTUM.—*Tenna maruttú pungic*, TAM.; *Tenkeia-chettú-puthic*, TEL.; *Tennam-púppa*, MAL.

HABITAT.—A pinnate-leaved palm, with a straight or often gracefully curved stem, marked by annular scars; cultivated throughout tropical India, and Burma, especially near the sea coast. On the eastern and western coasts it is particularly abundant, more so towards the south. There are several cultivated varieties but all flower in the hot season, the nuts ripening from September to November. Dr. Shortt states that in South India the Palm thrives at altitudes up to 3,000 feet above the sea, and he even mentions one on the Shevaroy Hills at 4,500 feet. Coconuts are abundant at Bangalore up to 3,000 feet.

Starting from the Bay of Bengal, the coconut palm follows the Gangetic basin inland for about 150 to 200 miles; from the western coast its cultivated distribution inland is much more limited, and in Kolaba, for example, is little more than half a mile from the beach. In very exceptional circumstances, or under the most careful garden cultivation, it may be seen further inland in Bengal than stated, and it even occurs in some parts of Assam. It is, however, essentially a plant of the coast, and luxuriates on the islands of the Indian Ocean. The Indian region of the coconut may thus be said to be the lower basins of the Ganges and the Brahmaputra and the Malabar and Coromandel Coasts. In the Brahmaputra valley it ascends to a greater distance from the sea than in the Gangetic; but in both it is an introduced tree as it nowhere occurs in forests far away from human dwellings. On the Malabar coast, and on the islands off the coast of India, it may be different; but even in these localities it rarely exists as a forest tree, although it is self-sown. It is abundant on the Laccadive Islands, and on the Nicobar group in the Bay of Bengal, but excepting the recent efforts at cultivation, it was formerly rarely met with on the Andaman Islands, which are only 72 miles to the north. It re-appears again, however, abundantly on the Cocos Islands, a small group lying some 30 to 40 miles still further north (where it is in no way cultivated). M. De Candolle states briefly the arguments in favour of an American as well as those of an Asiatic origin for this tree, and concludes by expressing the opinion that it most probably belongs to the "Indian Archipelago." Its introduction into Ceylon, India and China, he states, does not date further back than three thousand years "but the transport by sea to the Coasts of America and Africa took place perhaps in a more remote epoch, although posterior to those epochs when the geographical and physical conditions were different from those of our day."

CULTIVATION OF THE COCONUT.

It is commonly reported that there are in India 480,000 acres under the coconut. A number of passages from Indian authors will be found

scattered through the present account of the palm, which every now and again recur to the question of its cultivation. It may, however, be desirable to give here a brief abstract of the opinions published by the better known European writers, since from these may be gathered the results of scientific experiments.

SOWING.—Ripe nuts, carefully collected, should alone be employed as seed, and for this purpose they are usually gathered from February to May. Seed from very young and very old trees should be avoided. After having been kept for a month to six weeks they should be planted. This may take place in January to April, or again in August, provided the rains are not heavy. The seed-beds should be dug 2 feet deep and the nuts should be laid on their sides, leaving 2 inches of their surface exposed. Ashes, or ashes and salt, should be freely placed on the trenches; these act both as a manure and as a preventative against insects. The seed-bed thus prepared should be kept moist, but not soaked. The germinated seeds may be transplanted when they are in their second to their sixth or even twelfth month. In the Gadaveri district they are placed in their permanent position when three to four years old. In damp localities the transplanting may be done in the hot season.

TRANSPLANTING.—The seedlings should now be put out in the plantation, pits 12 yards apart having been prepared for them. In rich soils the pits may be small, but in poor soils 1 to 2 yards wide and 2 or 3 feet deep. In cold clay soils these pits should be filled with sand. In marshy land, walls should be constructed around them. Ashes are often recommended to be freely mixed with the prepared soil to be put into the pits, as this is supposed to prevent the attacks of the beetles that prove so destructive to the trees. Cultivation of turmeric, arrowroot, &c., in the pits, along with the coconuts, is believed to be beneficial. The soil round the seedlings is also often kept damp by a bed of leaves, particularly such as will not encourage, but rather check, the approach of ants into the prepared soil. If the soil be naturally poor, salt, ashes, paddy-straw, fish manure, goats' dung, and dry manures may be added during the first year.

TREATMENT OF PLANTATION.—By the end of the first year the normal leaves will begin to form, and at this stage the soil around the plants should be dressed and ashes added. Every succeeding year the ground should be opened out and manured about the commencement of the rains, the soil being replaced and levelled about the close of the rains. By the fourth year the stem begins to appear and has about 12 leaves; it is distinctly visible by the fifth year, when the tree has about 24 leaves. The spathes commence to be formed by the sixth year, and the stem is then 1 to 2 feet above the ground, but in exceptionally favourable climates and soils it may be three or four times that height. The first few spathes do not form fruits, but bye-and-bye they begin to do so, and in three or four more years the tree is in full bearing. Dr. Shortt says that in good soils and if watered, the coconut begins to yield in the fifth year, but in poor soils and if not watered they only commence to yield in the seventh or not till the tenth year. About six months after flowering the fruits set, and by the end of the year they are fully ripe.

Coconut palms may be easily transplanted, and indeed often with advantage. Some of the fibrous roots should be cut away, and manure, together with a little salt, placed in the pit in which it is intended to plant the tree.

YIELD.—As a rule a coconut throws out a spathe and a leaf every month each flowering spike yields from 10 to 25 nuts. The produce of a tree in full health and properly tended may be from 50 to 120 and even 200 nuts a year, the yield depending greatly, of course, on the suitablity of the

climate and soil for coconut cultivation ; a safe average would be 100 nuts a year to each tree in full bearing. The coconut will continue to bear for 70 to 80 years.

CULTIVATED FORMS.

There are five recognisable varieties of the coconut met with in Ceylon. These have been described as, *1st* the *Tembili*, a plant with an oval-shaped nut of a bright orange colour ; *2nd*, a more spherical form ; *3rd*, a heart-shaped fruit of a pale yellow colour, with an edible inner rind, which turns red when the outer skin is removed ; *4th*, the ordinary form ; *5th*, a small nut about the size of a Turkey's egg. This last form is rare but much admired. Spon (*Encycl*, 1353) says "there are some 30 varieties of coconut distinguished by the natives of the districts producing them, but many of these distinctions are obviously groundless." Repeated reference will be found throughout this article to the different forms which occur in India, but of these, with perhaps the exception of that met with in the Laccadives, scarcely any deserve special mention. The Laccadive small-fruited form, with a soft, fine, but strong coir, seems well worthy of special consideration where the object of cultivation is the production of fibre. Dr. Shortt says there are 30 different forms in Travancore. He adds : "The largest variety of coconut that I have seen and examined comes from Ceylon. I have occasionally seen specimens nearly as large from the Coromandel coast. There is a small dwarf variety which fruits while it is about 2 feet high; the plant continues to grow and with age attains to a height of from 10 to 15 feet." A small form is met with in East Africa that does not possess the fibrous pericarp. In Indian newspapers announcements of branched coconuts occasionally appear, as also of branched date palms. These are viewed with superstitious horror by the ignorant They are most probably the result of two plants growing together, or of two or more embryos in one nut.

SOIL.—The coconut "thrives best in low, sandy situations, within the influence of the sea breeze, and never attains the same perfection when grown inland." (*Spon's Encycl.*) Simmonds writes : "Soils suitable for a coconut plantation are variously described as below, particularly observing that stony grounds, or those overlying rocky foundations, are to be avoided :—

"1. Soils mixed with sand, either dark-coloured or river-washed.

"2. Where sand is mixed with clay, ferruginous earth, or black mould.

"3. Clayey soils where the under-strata consist of sand.

"4. Sand and clay, even when mixed with gravel and pebbles.

"5. The sea-shore banks of backwaters, rivers, tanks, and paddy-fields.

"6. Alluvium of rivers and backwaters, provided a yard and a half of land is to be generally seen above water-level.

"7. Marshy land even in brackish soils (but not where salt is formed in crystals by evaporation).

"8. All level lands exposed to the sea breeze where the soil is good, as the valleys between hills, tanks and ditches which have been filled up.

"9. Lastly, even the floors of ruined houses well worked up, and any places much frequented by cattle and human beings on account of the ashes and salts of ammonia from the urine, &c., deposited day by day in the soil."

Simmonds further says : "The nuts for seed should not, on being gathered, be allowed to fall to the earth, but be lowered in a basket or fastened to a rope. If let fall, the polished cover to the fibres will be injured and collect damp about the nut, or the shell inside may be cracked and the water disturbed. These are fatal injuries, or even if the plants still

grow, they will, on being transplanted, not make fresh roots, but produce weak trees having their fronds constantly drying up, nuts rarely matured, and often are even without kernel in those which appear perfect. If the nuts are allowed to dry on the tree before gathering, the plants are liable to be lost, not having water inside to cherish the growth of the sprout (before the actual roots shoot into the soil)."

"Nurseries should be somewhat exposed to the influence of the sun, though not too much heat; plants thus grown will even, though deficient in stature, be strong, and when transplanted will not fail, nor suffer from heat. The planting of the nuts should take place in January to April, and also in August, provided the rains are not heavy, and then the planter may expect fruitful trees to be produced when grown; but nurseries formed during the heavy monsoon will generally fail, or produce trees which will yield small nuts. Too much moisture of every kind is injurious to the plants." Speaking of soils Dr. Shortt says: The coconut requires alluvial and loamy soils for its successful growth, but my soil with a free mixture of sand and clay answers fairly well. Sea-sand where procurable is recommended to be thrown into the pits when the earth is being returned around the plants. Half-sand half-earth is considered the best material to fill up the pits with."

PECULIARITIES OF INDIAN CULTIVATION.

The following passages from the Gazetteers will be found instructive and of value to intending cultivators as having a special bearing on India :—

1. *In Bombay* (*Kolaba District*).—Of the liquor-yielding trees of this district the cocoa palm is the most important. "The moist climate, sandy soil, brackish water, and abundance of fish manure, make its growth so vigorous that the yield of juice is much in excess of the wants of the district. The trees are grown within walled-in or hedged enclosures, sometimes entirely given to coconut palms, in other cases partly planted with mangoes, jak, betel-nut, and other fruit trees. Every garden has one or two wells from which the trees are watered by a Persian wheel. In starting a coconut garden, a bed is prepared, and in it, at the beginning of the rainy season, from twenty to forty large, ripe, unhusked nuts are planted 2 feet deep. The bed is kept soaked with water, and after from three to six months the nuts begin to sprout. The seedlings are left undisturbed for two years. They are then, at the beginning of the rains, planted in sandy soil in rows about 18 feet apart, and with a distance of about 15 feet between the plants. For about a foot and a half round each plant the ground is hollowed 3 or 4 inches deep, and during the dry months the plants are watered daily or once in two days, and, once or twice in the year, enriched with fish manure or with a mixture of salt *nachni*. When nine years old the trees begin to yield nuts twice a year and sometimes thrice, 120 nuts being the yearly average yield from each tree. The trees, are then ready to be tapped. Each coco-palm, when ready for tapping, is estimated to represent an average outlay of about 18s. (R9).

"The coconut gardens are generally owned by high-caste Hindus, who let the trees to some rich Bhandári who has agreed to supply the owner of the liquor-shops with fermented or distilled juice. The Bhandári pays the owner of the garden R1 (2 shillings) a month for every three trees (*Kolaba Dist.*, *Bomb Gaz. XI.*, 28). Of the Thana District it is stated—"The seed-nuts are prepared in different ways. The best and oldest tree in the garden is set apart for growing seed-nuts. The nuts take from seven to twelve months to dry on the tree. When dry they are taken down, generally in April or May, or left to drop. When taken down they are either kept in the house for two or three months to let half of the water in the nut dry, or, if the fibrous outer shell is not dry, they are laid on the house-roof or tied to a tree to dry. After the nuts are dry, they are sometimes thrown into a well and left there for three months, when they sprout. If the nuts are left to drop from the tree, which is the usual practice in

Bassein, they are either kept in the house for some time and then left to sprout in a well, or they are buried immediately after they have fallen. When the nuts are ready for planting they are buried either entirely or from one-half to two-thirds in sweet land, generally from 1 to 2 feet apart, and sometimes as close as 9 inches. A little grass, rice-straw, or dry plantain leaves are spread over the nuts to shade them. If white-ants get at the nuts the grass is taken away, and some salt or saltish mud mixed with wood ashes and a second layer of earth is laid over the nuts. Nuts are sometimes planted as late as August (*Shraván*), but the regular season is from March to May (*Chaitra* and *Vaishákh*), when, unless the ground is damp and their inner moisture is enough for their nourishment, the nuts want watering every second or third day until rain falls. The nuts begin to sprout from four to six months after they are planted, and when the seedlings are a year or eighteen months, or, what is better, two years old, they are fit for planting. At Bassein the price of seedlings varies from 5*d*. (3 annas 4 pies) for a one or one and a half year old seedling, to 6*d*, (4 annas) for a two-year-old plant. In planting them out the seedlings are set about six yards (12 *háts*) apart in the 2-feet-deep holes, in which about 1¼ pounds (2 *tipris*) of wood-ashes have been laid to keep off white-ants, and the garden must be very carefully fenced to keep off cattle. The plants are then watered every second day, if not every day, for the first year ; every third day, if not every second day, for the second and third year ; and every third day, if possible, for the fourth and fifth year. Watering is then generally stopped, though some Bassein gardeners go on watering grown trees every seventh or eighth day. For two years after they are planted out the young trees are shaded by palm leaves or by growing *sutheli* plantains. During the rains, from its fifth to its tenth year, a ditch is dug round the palm and its roots cut, and little sandbanks are raised round the tree to keep the rain-water from running off. In the ditch round the tree, 22 pounds (4 *páylis*) of powdered dry fish manure (*kuta*) is sprinkled and covered with earth, and watered if there is no rain at the time. Besides fish manure the palms get salt-mud (*khára chikhal*) covered with the leaves of the croton-oil plant, *jepál erand* (Croton Tiglium), and after five or six days with a layer of earth ; or they get a mixture of cow-dung and wood ashes covered with earth ; or night-soil, which on the whole is the best manure. Palms suffer from an insect named *bhonga* which gnaws the roots of the tree, and from the large black carpenter-bee which bores the spikes of its half-opened leaves. When a palm is suffering from the attacks of the *bhonga*, a dark red juice oozes from the trunk. When this is noticed, a hole 3 inches square is cut in the trunk from 4 to 6 feet above where the juice is coming out, and is filled with salt, which drives away or kills the insect. To get rid of the boring bee, it is either drawn out by the hand, or it is killed by pouring into the spike assafœtida water or salt-water.

"A well-watered and manured tree, in good soil, begins to yield when it is five years old, and in bad soil when it is eight or ten years old. A palm varies in height from 50 to 100 feet, and is in greatest vigour between the ages of twenty and forty. It continues to yield till it is eighty, and lives to be a hundred.

"When the tree begins to yield, a sprout comes out called *poi* or *pogi* at the bottom of which is a strong web-like substance called *pisundri*. After about a fortnight the tree flowers, though few blossoms come to perfection. Many of the young nuts also fall off, and only a few reach maturity, A young nut is called *bonda*, a nut with a newly-formed kernel is called *shále*, and a fully-formed nut *nárel*. A good tree yields three or four times a year, the average number of nuts being about seventy-five." (*Gaz*., *XIII*., *I*., *295*.)

In the report of the Káthiwár District (*Bomb. Gaz. VIII., p.* 95), there occurs a short but interesting account of the coconut : "At Mahuva, in 1875, 1,500 acres were planted with 17,000 palms. At Kahndera there is

a garden with 7,000 palms, and there are about 2,000 of Bàhvnagar. The advantage of the coconut over the mango is the uniformity with which it bears." "A singular fact about the cocoa-palm is that it grows freely in solid limestone, provided a hole about 3½ feet deep by 3 feet in diameter is cut in the rock and filled with mould. All the trees at Gopnàth are planted in solid rock,"

In concluding this account of the cultivation of the coconut it may be stated that, according to the various district Gazetteers, there are from 30,000 to 40,000 acres under the palm, with about 100 trees to the acre. Kànara, Ratnàgiri, and Kàthiwàr appear to be the districts where the largest number of trees occur. Of Ratnàgiri it is stated that if grown for the fruits only, each tree gives a net yearly profit of 2*s.* 4½*d.* (R1-3).

II. *In Madras.*—The coconut palm flourishes in this Presidency, frequenting the banks of estuaries and backwaters, and abounding on the sandy tracts near the sea, especially along the Malabar and Coromandel coasts. Although met with in the Bombay Presidency, it is only plentiful in the southern division, and barely leaves the immediate coast. On nearing the Madras Presidency from Bombay it becomes more and more plentiful. Of its abundance on the Malabar coast an opinion may be formed from the description of the town of Cannanore, the clumps of the coconuts being said to be seen between the officers' houses, surrounding the cantonments in every direction, and extending in the distance as far as the eye can reach; the cantonment may be said to be embedded in a forest of these trees" (*Royle*). Of South Kànara, it has been estimated that there are 89,000 acres under the coconut. Indeed, the Malabar coast and the Laccadive and Maladive Islands are preeminently the seats of the Indian coconut industry. The enquirer after Indian coconuts, coir, or coconut oil, need practically concern himself with no other part of the country unless he add to these the Nicobar Islands. The last mentioned islands furnish a very large number coconuts, but apparently the islanders are ignorant of, or too indifferent to learn, the art of making coir, or expressing the oil. So far this remark seems to be almost applicable to the Maladives also, a group of large islands under a Sultan, who is subordinate to the Governor of Ceylon, and not the Viceroy of India. This fact is of some importance, since the casual examination of the trade returns might convey the idea that the Laccadives expert no coir, if the still further error might not even be committed of supposing the Laccadives to contain no coconuts at all. The Laccadives are mainly under the administration of the Collector of Malabar, and the imports from these islands are treated as if they were the produce of the mainland, while the imports from the Maldives are returned as from foreign territory. Last year the Maldives sent 7,897,453 coconuts to India, and the Nicobar Islands 4,510,000 Of the inhabitants of these groups of Islands it is not reported that they manufacture coir, and apparently they prepare only a small amount of copra, although they sell their nuts at a price far below that which prevails on the mainland of India.

Writers in Europe, who have described the commercial article Coir, are in the habit of placing the coir from Cochin in the first rank. Some doubt seems to be associated, however, with the commercial term "Cochin Coir. The small Native State probably alluded to is described in the *Imperial Gazetteer* "as possessing no important trade by sea or land." It seems impossible to believe that all the coir returned under the name of "Cochin Coir," could therefore come from Cochin. Indeed, the suspicion exists that the better class of Malabar and Laccadive coir, consigned to Europe, may be so designated, if not also some of the exports of coir from Cochin-China and the Straits. In the returns of the coasting trade for British India it is shown that last year the total exports of coir from Cochin by sea amounted to only 689 cwt., valued at R4,134, and manufactured coir 2,777 cwt., valued at R25,339; these were all sent to Bengal or Bombay; how much may have

gone by land to Madras cannot be discovered. It is significant that Dr. Shortt in his Monograph on the coconut palm, which has just appeared, makes no mention of Cochin coir.

Repeated reference will have to be made, in subsequent pages, to the Laccadive and Malabar coir and the other coconut products from these regions, so that we shall here content ourselves with this brief notice of Madras, concluding only by giving the description of the cultivation given in *Morris's Descriptive and Historical Account of the Godavery District*:—"Young plants of a year's growth are planted out, and watered for six years, after which they do not require much water. The trees generally bear fruit about the ninth year after transplantation. The expenses of cultivation are stated to be R668 for a *putti* of land,—namely, R140, being the price of 600 young plants, R48 being the value of the labour required for planting them, and R480 being the wages of labourers employed to water and tend the trees until they come into bearing. When the trees begin to bear fruit, the value of the produce of a tree, exclusive of the fibre, is estimated at about 12 annas a year, making the total value of the produce in a *putti* of land R300" (*p. 70.*)

III. *In Mysore* "there are four varieties of the coconut: *1st*, red; *2nd*, red mixed with green; *3rd*, light green; and *4th*, dark green. These varieties are permanent., but although the red is reckoned somewhat better than the others, they are commonly sold promiscuously. Their produce is nearly the same.

"The soil does not answer in the Bangalore district unless water can be had on digging into it to the depth of 3 or 4 cubits, and in such situations a light sandy soil is the best. The black clay, called *ere*, is the next best soil. The worst is the red clay, called *kebbe*; but with proper cultivation all the three soils answer tolerably well.

"The manner of forming a new coconut garden is as follows: The nuts intended for seed must be allowed to ripen until they fall from the tree, and must then be dried in the open air for a month without having the husk removed. A plot for a nursery is then dug to the depth of 2 feet, and the soil is allowed to dry three days. On the *Ugádi* feast (in March) remove 1 foot of earth from the nursery and cover the surface of the plot with 8 inches of sand. On this, place the nuts close to each other, with the end containing the eye uppermost. Cover them with 3 inches of sand and 2 of earth. If the supply of water be from a well, the plot must once a day be watered; but if a more copious supply can be had from a reservoir, one watering in the three days is sufficient. In three months the seedlings are fit for being transplanted. By this time the garden must have been enclosed, and hoed to the depth of 2 feet. Holes are then dug for the reception of the seedlings at 20 feet distance from each other in all directions, for when planted nearer they do not thrive. The holes are 2 feet deep and a cubit wide. At the bottom is put sand 7 inches deep, and on this is placed the nut with the young tree adhering to it. Sand is now put in until it rises 2 inches above the nut, and then the hole is filled with earth and a little dung. Every day for three years, except when it rains, the young tree must have water.

"The coconut palm begins to produce when seven or eight years old, and lives so long that its period of duration cannot readily be ascertained. Young trees, however, produce more fruits which comes forward at all seasons of the year. A good tree gives annually a hundred nuts. A few are cut green on account of the juice, which is used as a drink, but by far the greater part are allowed to arrive at some degree of maturity, although not to full ripeness, for then the kernel would become useless.

"Coconut palms are planted in Chiknayakanhalli in rows round the arecanut gardens, and also separately in spots that would not answer for the cultivation of this article. The situation for these gardens must be rather low, but it is not necessary that it should be under a reservoir; any place will answer in which water can be had by digging to the depth of two men's stature. The soil which is here reckoned most favourable for the coconut is a red clay mixed with sand. It must be free of lime and saline substances. Other soils, however, are employed, but black mould is reckoned very bad. The coconuts intended for seed are cut in the second month after the winter solstice. A square pit is then dug, which is sufficiently large to hold them, and is about a cubit in depth. In this, fifteen days after being cut, are placed the seed-nuts, with the eyes uppermost and contiguous to each other, and then earth is thrown in so as just to cover them, upon which is spread a little dung. In this bed, every second day for six months, the seed must be watered with a pot, and then the young palms are fit for being transplanted. Whenever, during the two months following the vernal equinox, an occasional shower gives an opportunity by softening the soil, the garden must be ploughed five times. All the next month it is allowed to rest. In the month following the summer solstice, the ground must again be ploughed twice; and next month, at the distance of 48 cubits in every direction, there must be dug pits a cubit wide and as much deep. In the bottom of each a little dung is put; and the young plants, having been previously well watered to loosen the soil, are taken up and one is placed in each pit. The shell still adheres to the young palm, and the pit must be filled with earth so far as to cover the nut. Over this is put a little dung. For three months the young plants must be watered every other day; afterwards every fourth day, until they are four years old, except when there is rain. Afterwards they require no water.

"Every year the garden is cultivated for *ragi*, *uddu*, *hesaru*, or what ever other grain the soil is fitted for, and is well dunged, and at the same time four ox-loads of red mud are laid on the garden for every tree that it contains, while a little fresh earth is gathered up towards the roots of the palms. The crop of grain is but poor, and injures the palms; it is always taken, however, as, in order to keep down the weeds, the ground must at any rate be ploughed, as the manure must be given, and as no rent is paid for the grain. On this kind of ground the coconut palm begins to bear in twelve or thirteen years, and continues in perfection about sixty years. It dies altogether after bearing for about a hundred years. They are always allowed to die, and when they begin to decay a young one is planted near the old one to supply its place.

"In this country, wine is never extracted from this palm, for that operation destroys the fruit, and these when ripe are considered as the valuable part of the produce. A few green nuts are cut in the hot season, on account of the refreshing juice which they then contain, and to make coir rope; but this also is thought to injure the crop. The coir made from the ripe nuts is very bad, and their husks are commonly burned for fuel.

"The crop begins in the second month after the summer solstice, and continues four months. A bunch is known to be ripe when a nut falls down, and it is then cut. Each palm produces from three to six bunches, which ripen successively. A middling palm produces from 60 to 70 nuts. As the nuts are gathered they are collected in small huts, raised from the ground on posts. When a merchant offers, the rind is removed at his expense, by a man who fixes an iron rod in the ground, and forces its upper end, which is sharp, through the fibres, by which means the whole husk is speedily removed. He then, by a single blow with a crooked knife, breaks the shell without hurting the kernel, which is then fit for sale and is called *koppari*. A man can daily clean 1,300 nuts. From 20 to 30 per cent. of them are found rotten" (*Mysore Gazette*, *I.*, *131-134*).

IV. *On the Nicobar Islands* the coconut palm is very abundant, although, as already stated, it exists only under recent cultivation on the Andaman Islands, but reappears still further to the north on the group of the Cocos Islands. Sir W. W. Hunter gives an interesting account of the Nicobar trade in coconuts which may be here quoted: "At present the principal product of these islands is the coconut palm, and its ripe nuts form the chief export." "The northern islands are said to yield annually 10 million coconuts, of which about half are exported. The estimated number exported in 1881-82 was 4,570,000. As this important product is six times cheaper here than on the cost of Bengal or in the Straits of Malacca, the number of English and Malay vessels that come to the Nicobars is every year increasing." "The trade in coconuts is carried on chiefly by native craft from Burma, the Straits Settlements, Ceylon, &c. Forty vessels of an aggregate tonnage of 6,270 tons visited the islands for coconuts in 1881-82.' The Administration Report for 1885-86 gives the exports as 4,510,000 nuts and 5,730 bags of copra. In that year 49 vessels, with an aggregate tonnage of 8,218 tons, obtained permission to trade with the Nicobar Islands for coconuts, &c. The same report states that there are now 112,000 coconut palms under cultivation at Port Blair.

V. *Of Burma* it is reported that the coconut is "largely cultivated and might be much more so in many places along the Arakan coast as it is in Ceylon, and as doubtless it would be but for the sparseness of population, the difficulties of approaching the coast except at a few spots, and the absence of the means of land communication between ports and the sites fitted for the production of the trees." In the Bassein district of Pegu it has been stated that there are 10,000 acres under coconuts.

In Bengal, while the palm is plentiful throughout the lower Gangetic basin, it exists only in garden cultivation, and the produce is not much in excess of the local demand. There are no large plantations such as have been described in Madras, Mysore, and Bombay, because in Bengal the date palm is used as the source of palm-juice or toddy and not the coconut. It is however, fairly abundant in Noakhally, Backerganj, Jessore, and the 24-Parganas.

VII. *In Upper India* the coconut is alluded to in many works, but only as an article of import and export; it is not cultivated. Dr. Hartwig (*Tropical World*) says: "This noble palm requires an atmosphere damp with the spray and moisture of the sea to acquire its full stateliness and growth; and, while along the bleak shores of the Northern Ocean the trees are generally bent landward by the rough sea-breezes, and send forth no branches to face its violence; the cocoa, on the contrary, loves to bend over the rolling surface, and to drop its fruits into the tidal wave. Wasted by the winds and currents over the sea, the nuts float along without losing their germinating power, like other seeds which migrate through the air; and thus, during the lapse of centuries, the cocoa-palm has spread its wide dominion from the coast to coast, through the whole extent of the tropical zones."

VIII. *Ceylon.*—Speaking of Ceylon cultivation Mr. Treloar says: "The ripe fruits are first planted in a nursery, where they are covered an inch deep with sand and sea-weed or soft mud from the beach, and watered daily till they germinate. In two or three months a white shoot containing the foliaceous rudiments springs from one of the three holes in the end of the nut; the radicals emerging from the other two orifices opposite to the shoot, and penetrate the ground." This is not quite a correct description of the germination. The leaf-stalk of the cotyledon elongates and pushes the embryo bodily out of the seed. The blade of the cotyledon remains within the nut forming a sort of arm of attachment. The lower point of the projected embryo elongates and forms the roots, and from a slit in the cotyledonary sheath the plumule or stem makes its appearance. The "three holes" on the nut are all close together, not "opposite" as in the above

description and are only spots not holes. But Mr. Treloar proceeds: "The nuts set in April, grow large enough in about four months to be planted out before the annual rains, but for the next two or three years or more the young plants require constant care. They must be watered and shaded from the glare of the sun by screens of plaited leaves from the coconut tree or the fan-shaped fronds of the palmyra."

ENEMIES TO THE COCONUT.

It is commonly stated that if the soil be too rich a large grub with a reddish-brown head soon finds it way to the roots and into the stem. This eats its way through the tissues until the leaves turn yellow, the terminal bud withers, and the tree is killed. This appears to be the beetle known as *Butocera rubus*. "In the Straits of Malacca, the chief natural enemy of the tree is a species of elephant beetle, which begins by nibbling the leaves into the shape of a fan: it then perforates the central pithy fibre, so that the leaf snaps off; and lastly, it descends into the folds of the upper shoot. where it bores itself a nest. and if not speedily extracted or killed, soon destroys the tree. A similar kind of beetle is known on the Coromandel coast, and is extracted by means of a long iron needle or probe, having a barb like that of a fish-hook. By using this and by pouring salt or brine on the top of the tree, so as to descend amongst the folds of the upper shoots, the evil may be prevented or got rid of." This destructive beetle is known to entomologists as *Calandra Palmarum*; but still another beetle bores round holes into the stem itself and lives there. Rats, flying-foxes, and squirrels injure the tree and sometimes kill it by eating the tender terminal bud or cabbage. It is equally necessary to protect the trees from wild hogs, elephants, cows, porcupines, all of which graze on the young plants. But of the dangers to which the coconut is subject none are so great as the attacks of beetles, two of which are alluded to above. Mr. Treloar says of Ceylon: "Still more formidable is the *Cooroominyo* beetle (*Butocera rubus*,) which waits to pierce the tender trunk near the ground, and to deposit its eggs in the cavity whence the young grubs, directly they are hatched, begin to eat their way up through the centre of the tree to the young leaf-ends at the top. The West Indian plantations are said to have been devastated by the attacks of a small beetle (*Passalus tridens*), and a similar calamity is reported to have occurred in Zanzibar through a species *Oryctes*.

The Burmans are adepts at detecting the beetles in date and coconut palms, and extract them as prized articles of food.

GUM.

The stem of this well-known tree is in Tahiti said to yield gum. It forms large stalactitic masses, red-brown, translucent or transparent. (*Spon's Encycl.*) Cooke, in his report on gum and gum-resins, says that this gum was sent to the Madras Exhibition of 1855 from Travancore. No other author appears to allude to this gum, however, and it therefore seems probable that if produced it is met with only in certain localities. The writer cannot recollect ever having seen a gum adhering to the stems of the palm.

DYE.

In a patent obtained by Mr. J. H. Baker (No. 5,139, March 29th, 1825) the whole or every part of this tree is claimed as a dye-ware, especially the husk enclosing the fruit, and the foot-stalks of the leaves. The dye was to be extracted by water, cold or boiling, or by solutions of lime, potash, ammonia, &c., and was to serve for dyeing nankeens, blueblacks, &c. The infusion was likewise to serve as a substitute for nutgalls in Turkey-red dyeing. The material does not appear ever to have come into practical use." (*Crookes.*)

Mr. Liotard says of this dye property:—"Produces a dirty-brown (*khaki*) colour and is a good deal used from its abundance. Lime and *chaula* are added as mordants." Drury remarks that "the shell when burnt yields a black paint which in fine powder and mixed with *chunam* is used for colouring walls of houses." Coconut oil is frequently employed in certain processes of dyeing. Thus in Mysore powdered myrobalams and sulphate of iron mixed with coconut oil are used for imparting a black colour to silk. It is not known whether any other oil might serve the purpose of the coconut,—in other words, whether or not that oil possesses special properties that assist the tinctorial actions.

The natives of India generally do not seem to be aware of the dye properties. The milk is, however, said to be used by plasterers both in India and Ceylon, from an idea that when mixed with lime or colour-washes it increases the adhesive property and gives a polish. For this purpose vegetable matter of some kind is, as a rule, added to cements.

COIR FIBRE.

The thick pericarp or outer wall of the fruit yields the valuable coir fibre of commerce. The sheaths of the leaves are used to wrap up articles, and as paper to write upon. At the Colonial and Indian Exhibition the writer proposed that they should be tried as a means of strengthening harness, the softer layers being even used for corsets and as surgical splints. The fibre of the leaf-stalks is also prepared. and might prove useful in the manufacture of paper. A delicate tomentum or cotton is often seen at the base of the leaf; this used as a styptic. But the most important fibre yielded by the coconut palm is of course coir. The name of this fibre is said to come from the Malayalam *káyar* (from the verb *káyaru*, to twist) through the Portuguese corruption *coiro*. "The word appears in early Arabic writers in the forms *kánbar* and *kanbár*, arising probably from some misreading of the diacritical points (from *káiyar kaiyár*)" (*Yule & Burnell*). *Kayer* is said to be also the Tamil for a rope.

Both the fibre and the rope were first exported to Europe about the middle of the sixteenth century, but it was not until the great International Exhibition of 1851 that coir rope and coir matting attained a commercial importance in England. The merit of this modern trade is largely due to the efforts of the following firms. *viz.*, Messrs. Chubb, Round & Co., and Messrs. Treloar & Sons of London; the Oriental Fibre Mat and Matting Co. Highworth, Wilts; Messrs. W. I. Sly and T. Wilson of Lancaster, who were the patentees of improved machinery for making figured fabrics of coir.

Although a considerable amount both of coir fibre and yarn is exported from India, the article, taking India as a whole, is obtained chiefly as a by-product. It is accordingly inferior in quality and colour to the special coir obtained from Cochin, the Laccadives, Madras, Malabar, Ceylon, Singapore, &c. Locality seems to exercise a considerable influence over the quality of the fibre,—soil, climate, and proximity to the sea being important influences. But there are other considerations. Certain varieties or cultivated forms of the coconut are better suited than others for the production of coir. If cultivated specially for the supply of juice or to afford fruit, the fibre would appear to be in the one case imperfectly formed and in the other overgrown. A great deal depends upon the collection of the fruit at the exact time the fibre is mature, and this followed by an accurate system of steeping, beating, and cleaning the fibre, completes the manipulation calculated to produce the superior qualities of coir. (*Conf. with Mr. Jackson's report in next para*) "The fibre appears in the market in various degrees of fineness, depending on the age at which the coconut was cut and husked, and the care bestowed in steeping and cleaning." Mr. Treloar says: The usual indications are that the commoner and coarser fibre comes from the old

nuts, and the finer, lighter quality, from the new; but there are, of course, essential differences in the qualities brought from each locality, and the Cochin are usually the best." "Here let it be parenthetically but emphatically remarked that *any attempt to give to coconut fibre a fairer hue by the process of bleaching is to destroy its quality if it be good, and if it be of common quality to make it almost worthless.*"

Properties of the Fibre and Season when Mature.—"The Cochin has the purest hue and fetches the best price." On this account it has been customary to imitate this by bleaching. "Coconut fibre is tough, elastic, springy, easily manipulated within certain limits, and eminently suitable for manufactures where lightness, cleanliness, and great indestructibility are required. It will stand water, is almost impervious to wind and wave, or to damp and rain, and, as we have seen, flourishes in the saline breath of the sea; but it will not stand bleaching. It gives up when confronted with sulphuric acid, chloride of tin, or any other chemicals which are designed to convert it into a sham product. *For this reason we use none but unbleached fibre in any of our manufactures*; and although two or three varied shades of colour are frequently to be seen in one of our ornamental mats, and sometimes form a simple, pleasing pattern, they are obtained by combining or incorporating in the same mat different descriptions of *natural* unbleached fibre." *Spons' Encyclopædia* has it that the fibre "is much impaired by waiting for the nuts to arrive at maturity, consequently, for fibrous purposes, the latter are usually cut at about the tenth month. If cut earlier than this, the fibre is weak; if later, it becomes coarse and hard, requires a longer soaking, and is more difficult to manufacture." Dr. Buchanan Hamilton in his journey across Mysore states (*I., 156*) the green coconut are sold for their husks, from which fibre is extracted, but the husks of the ripe coconuts are commonly burnt for fuel (*II., 50*). At the same time immense quantities of apparently ripe coconuts, in husks, are sent to Europe, the coir from the husk being there separated, cleaned, and manufactured. Mr. Jackson of Kew in the *Planters' Gazette*, describing a visit to Messrs. Chubb, Round & Co.'s factory, gives an interesting account of the process of husking there pursued. He says: "the enormous heap of husks—which, indeed, is known in the locality as the 'mountain'—comes into view immediately upon entering the premises, and one can scarcely, at first sight, realise the fact that the enormous pile is composed entirely of these apparently useless portions of the fruit. At the time of my visit this reserve stock of husks was estimated at considerably over a million and a half.' Coconuts, or as they are generally termed in the trade, "Cockernuts," to distinguish them from the Theobroma Cacao, which furnishes cocoa and chocolate, are shipped principally from Trinidad, Jamaica, Demerara, Tobago, several of the other Leeward Islands in the British West Indies, Ceylon, Belize (British Honduras), all round the coast of America, and the Fiji Islands. Nearly all the nuts are imported in the husk or outer covering, from which, on arrival, they are stripped by men using two fine-pointed steel chisels, and who, by constant practice, become so skilful in the art that many are able to open 1,000 to 1,200 nuts per day. The nuts themselves after being removed from the husks are generally sold to wholesale fruit dealers, who, in turn, supply the retailers, costermongers and others, &c." In the above passage Mr. Jackson has furnished the Indian people with new ideas. India is not enumerated by him as one of the countries that furnish coconuts to England; the fibre of what appear to be mature coconuts is actually used; the consumption of coconut kernel has in England attained a vast proportion, and the fibre can be cleaned after apparently having been kept for years on the nut. These facts open up a new field of trade of which with a little assistance the Nicobar and Laccadive Islands might profitably and without fear of any rival hope to enjoy a large share.

Separation of Coir in India.—"The removal of the fibre from the shell is effected by forcing the nut upon a pointed implement stuck into

the ground; in this way a man can clean 1,000 nuts a day. The fibrous husks are next submitted to a soaking, which is variously conducted. In some places they are placed in pits of salt or brackish water, for 6 to 18 months; in other places, fresh water is used, but it becomes foul and injures the colour of the fibre. The chief point to be considered is the duration of the soaking; if it be continued too long, the fibre will be weakened; if it be curtailed, the subsequent extraction and cleansing of the fibre will be rendered more difficult. The most approved plan of conducting the soaking is in tanks of stone, brick, iron, or wood; steam is admitted to warm the water. By this means the operation is rendered very much shorter, and the fibre is softened and improved. The further separation of the fibre from the husk is largely effected by hand. After thorough soaking, the husks are beaten with heavy wooden mallets "and then rubbed between the hands." *Spons' Encyclop:* Royle and Marshall give the same facts.

Robinson describes the separation and cleaning of the fibre as practised in the Laccadive Islands as follows:—"When soaked sufficiently long, it is taken out of the pit and beaten with a heavy mallet. Subsequently it is said to be rubbed with the hands until all the interstitial cellular substance is separated from the fibrous portion. When quite clean it is arranged into a loose roving preparatory to being twisted, which is done between the palms of the hands in a very ingenious way, so as to produce a yarn of two strands at once."

"As the husk gets hard and woody if the fruit is allowed to become quite ripe, the proper time for cutting it is about the tenth month. If cut before this, the coir is weak: if later, it becomes coarse and hard, and more difficult to twist, and requires to be longer in the soaking pit, and thus becomes darker in colour. When cut, the husk is severed from the nut and thrown into soaking pits. These, in some of the islands, are merely holes in the sand, just within the influence of the salt water. Here they lie buried for a year, and are kept down by heaps of stones thrown over them to protect them from the ripple. In others, the soaking pits are fresh-water tanks behind the crest of coral. In these, the water, not being changed, becomes foul and dark coloured, which affects the colour of the coir. When thoroughly soaked, the fibrous parts are easily separated from the woody by beating. If taken out of the pits too early, it is difficult to free the coir from impurities; if left in too long, the fibre is weakened, as is said to be the case also with that soaked in fresh water," (*Robinson's Report on the Laccadives.*) In the Maldives (neighbouring islands under the suzerainty of the Governor of Ceylon) coconuts are very plentiful, and enormous quantities of both the nut and the fibre are exported to India and Ceylon. (*See the further paragraph on trade in nuts.*)

From what has been said in an early paragraph regarding the cultivation of the coconut palm in Mysore, it will be seen that the opinion prevails that if tapped for the juice the fruit bearing is materially injured. If this be a fact ascertained and borne out in other parts of the country, it might be inferred that regions like the Malabar coast, where tapping is largely practised, would not be suited for the production of good fibre. On the other hand, Royle says: But the fruit-bearing power of the trees may be considerably improved by extracting toddy from the blossom-shoots for the manufacture of jaggery during the first two years of its production, after which it may be discontinued. In the Konkan the opinion is held that "if tapped the trees become unproductive much sooner."

The Bombay process of extracting the fibre is briefly described in the *Bombay Gazetteer* of the Thana district; "The fibrous part of the outer coating is made into coir by the Bassein gardeners. For this purpose the fibres are stripped from the nuts, left under water for two months, and then

beaten by a wooden mallet." The writer cannot discover any detailed description of the process adopted in India generally (except that of the Laccadives) for the separation, steeping, and cleaning of the fibre, but to the best of his knowledge it agrees with what has already been given; although in the Laccadives, the Malabar Coast, Ceylon, and other important coir-producing countries, the art is carried to greater perfection the fibre being correspondingly superior to that prepared on the mainland of India. Large portions of the coast of India (see above in a passage from the *Burma Gazetteer*) are so inaccessible that the methods pursued in Ceylon and elswhere are scarcely applicable, and, indeed, where applicable, are not pursued, from the greater importance attached to the palm as a supplier of toddy or juice. Dr. Stocks urges that the coconut might with advantage be cultivated on the brackish soils in the neighbourhood of Karachi, and it seems possible that a coir industry might there be developed. It has been reported that in Madras coconut cultivation has been successfully prosecuted in the reclamation of salt-impregnated lands where nothing else would thrive. (*Gen. Admin. Report, p. 95*). A curious fact in regard to coconuts grown on salt marshes is conveyed by the following passage :—

"The coconuts growing in mangrove soils, on the side of creeks, and more or less saturated with salt, have their milk brackish, and the sap is saline also. These trees do not suffer from the attacks of the rhinoceros beetle, and are found to bear much sooner than those planted in a sandy soil" (*p. 182-83*).

INTERESTING FACTS CONNECTED WITH THE TRADE IN INDIAN COIR.

Although, as suggested, the better class fibre is most likely not produced where tapping for the juice is practised, still it should not be forgotten that the Malabar ports are the chief seats of the export of coir, from India. In most works (written in Europe) on the subject of coir, the statement is made that the best quality comes from "Cochin." As already stated, it is not quite clear, however, whether the Native State of Cochin or the whole of the Malabar coast is meant, or whether Cochin coir is a mere commercial term for all good coir wherever obtained. In the Indian regions alluded to above, coconut cultivation is prosecuted to a considerable extent. Of Cochin (Madras) it may be said, coir is perhaps the most important article of export from that Native State, but Dr. Shortt (*in his Monograph on the Coconut Palm*) does not apparently mention Cochin coir. He states that the best Madras coir comes from the Laccadives, Amindivi, Kadamat, Kiltan, and Chetlat. As indicated by the passage quoted above from Mr. Jackson's paper Messrs. Chubb, Round & Co. do not, it would seem, use any Cochin fibre but prefer a husk which they separate from a mature or at least edible nut.

In a recent report on the trade of Madras, the progress of the coir industry of that presidency for the past twenty-five years is shown. The average export to Foreign and Indian ports for the five years ending 1860-61 were 148,220 cwt., valued at R3,74,804; and for the five years ending 1880-1881, they were 271,934 cwt., valued at R21,79,767, while for the year 1881-82 they were R23,54,292. Of the last mentioned valuation, the exports from the Malabar coast alone amounted to R22,43,000. From these figures a definite idea may be obtained of the immense importance of Malabar and the Laccadives as the chief seats of the Indian coir industry, since the Madras Presidency heads the list of Indian exports. This idea is borne out by the statement made by Royle that "the Laccadive Islands are famed for the good quality of the coir which is made there and exported to the Malabar coast." Again, speaking of the peculiar form of the palm grown in the Island of Kiltan, Royle observes: "It requires no attention and comes into bearing early. The tree is not so large and strong as that of the coast, and the nut about two-thirds of the size only, and round in shape. The husk is smaller and less woody, and the fibre finer

and more delicate but stronger than that of the coast nut. The nut is also said to be more compact and oily, and to keep better than the coast nut, although, for the sake of coir, the nut is cut before being quite ripe." How far the exports of coir from the Malabar coast correspond to Indian-grown coir cannot be discovered. The Northern Laccadives are administered by the collector of Malabar and the Southern by Alì Ràjà of Cannanore. Sir W. W. Hunter (in the *Imperial Gazetteer VIII*, 394) says: "The article (coir) is paid for to the producers at fixed prices, and is sold on the coast at the market rates; the difference constitutes the revenue or profits of trade of the Government and Alì Ràjà respectively. The latter pays a fixed tribute of R10,000 (£1,000) to the Government on account of the islands which he manages. No change has been made for many years in the price which is given by Government for the coir produced in the islands attached to Kànara." The returns of the coasting trade of India do not specify the amounts of coir sent from the Laccadives to Malabar, so that the somewhat interesting subject of how far the juice-extracting industry of the coast is combined with the preparation of fibre cannot be definitely learned. The following facts are, however, instructive :—

IMPORTS of coir (manufactured and unmanufactured) into Madras from other Indian ports—

	Cwt.	Rs.
1884-85	14,745	95,884
1886-87	13,750	81,386
EXPORTS to other Indian ports—		
1884-85	186,869	12,66,356
1886-87	128,228	7,98,255

Turning to the tables that give the details of these figures it is shown that of raw or unmanufactured coir Madras receives none from British or foreign Indian ports, so that unless the Laccadives, which (as stated above, are treated as part of Malabar), furnish a very large amount, a considerable local production must exist on the Malabar coast to allow of the extensive exports given above, and the still larger exports shown in the returns of foreign trade. In the *Imperial Gazetteer* it is stated of the Malabar district alone that "the value of exported coconut products is estimated at nearly a million sterling annually."

In a previous page some indication of the extent of the Nicobar trade in coconuts has been given. There does not, however, appear to be any trade in coir, although it seems possible that one of the inducements that bring the native and other crafts from Ceylon and the Straits, for the cheap Nicobar coconuts, may be to use these in supplementing their home supplies—supplies which are in much demand in the coir market. It may be worth while suggesting that an effort might with advantage be made to instruct the Natives of the Nicobars in the art of preparing the coir fibre—an art so profitably practised by their neighbours, the islanders of the Laccadives. This is, indeed, one of the most hopeful aspects of a possible enhanced Indian trade in coir, until such time as the cultivaton of the palm can be more vigorously prosecuted along the Coromandel coast to Burma. It seems remarkable that the cheap coconuts sold in the Nicobar Islands should attract traders from Ceylon and the Straits, while India appears to make little or no effort to participate in the advantages of that trade. This is perhaps due to the administrative arrangement which has associated the Maldive Islands with Ceylon instead of India, the Ceylon traders calling at the Nicobar as well as the Maldive Islands.

YIELD PER NUT OF FIBRE AND PRICE.

Mr. Robinson, in his *Report on the Laccadives*, states that the difference in the quantity of coir manufactured from a coast nut and from an island nut in very considerable. We may premise that 40 coconuts are said to yield 6 lb. of coir in Ceylon. Mr. Robinson remarks: "Three large coast nuts will yield 1 lb. of coir, measuring 22 fathoms; whereas, ten

small, fine island nuts go to about 1 lb. of coir, but this will measure 35 fathoms; 2 lb. of such yarn, measuring from 70 to 75 fathoms, are made upon into *sooties* of which there are 14 to a bundle, averaging about a maund of 28 lb. A Mangalore candy of 560 lb. will thus be the produce of 5,600 nuts, and should contain about 20,000 fathoms of yarn. The actual price of coir received by the Islanders is about R13 per candy. The value of the coir produce of a tree is calculated to be from 2 to $2\frac{1}{2}$ annas; and that of the produce of 100 trees from R13 to 15," The average value of the total raw produce of a tree bearing fruit would then be seven annas to half-a-rupee; and that of plot of 100 trees, R45." For the nuts which they export to the Malabar coast they got from R7 to 10 per thousand, or rather, 1,100, as 10 per cent. is always allowed for the luck in these sales. The Islanders export from 300,000 to 400,000 nuts annually. The natives bring their coir to the coast in March and April which is then received into the Government godowns. Until the year 1820 all coir was paid for at the rate of R21-14-0 per Mangalore candy, or R25 per Calicut candy of 640 lb. After that year the coir was divided into three classes. Since then the average price paid for a Mangalore candy, of Ameendevy and Kadamat coir has been R20-2-0 (or R23 per Calicut candy of 640 lb.) But for the Kiltan and Chetlat coirs, which are the best. an average of R20-12-7 or R23-12-0 per Calicut candy is paid. Up to A.D. 1825-26, the Bombay and Bengal Governments took almost the whole of the coir brought from these islands, and credited the Mangalore Collectorate with R25 per candy. The price has since fallen very much during the last twenty years. It has been frequently below the price paid to the islanders, and at best has never yielded above 12 to 20 per cent profit. The average imports of coir have been from 500 to 600 candies. Mr. Morris, in his account of the Godavery district, Madras, give the following brief statement regarding the production and yield of coir:—

"The Coconut tree yields an excellent fibre. The quantity of fibre in the above extent of land (a *putti*) is estimated at 150 maunds, yielding R93-12-0, at 10 annas a maund. The fibre is prepared by the outer covering of the coconut being moistened and beaten with wooden mallets, after the fibre has thus been loosened. The coir thus obtained is twisted into ropes. The fruit is exported, but very little of the fibre." *Morris's God. Dist. 70.*)

Spons' Encyclopædia gives the London prices of coir as "Cochin—good to fine, £19 to £25 a ton; coarse, £16-10s. to £19-15s. Yarn—good to fine, £26-10s. to £46 a ton; medium, £21.5s. to £28-10s.; common, £14 to £22-10s.; roping, £18 to £24."

USES OF COIR.

"The fibrous husk of the coconut is not its least valuable product. and gives rise to a very large trade, both in the East and in Europe. At first it was only used in this country (England) for stuffing mattresses and cushions, but its applications have been enlarged and its value greatly increased by mechanical processes, and in a small pamphlet issued by Mr. Treloar, more than twenty years ago, he stated that its natural capabilities having been brought out, coir has been found suited for the production of a variety of articles of great utility and elegance of workmanship—table-mats, fancy baskets, and bonnets, &c. Instead of being formed into rough cordage only, and mats made by hand, by means of ingeniously-constructed machinery the fibre is rendered sufficiently fine for the loom, and matting of different textures and coloured figures is produced, while a combination of wool in pleasing designs give the richness and effect of hearthrugs and carpeting. Brushes and brooms for household and stable purposes, matting for sheep-folds, pheasantries, and poultry yards, church cushions and hassocks, hammocks, clothes lines, cordage of all sizes, and string for nurserymen and others, for tying up trees and other garden purposes; nosebags for horses, mats and bags for seed-crushers, oil-pressers

and candle-manufacturers, are only a few of the varied purposes to which the fibrous coating of the coconut is now applied." (*Simmonds, Trop. Agri.*, *234.*) The uses of coir are of course so varied and extensive that it is scarcely necessary to enter upon them in greater detail than indicated in the above passage. To the natives of India it is invaluable as lasting in a damp climate. It is accordingly universally employed in tying the bamboos used in the construction of their huts.

Fibrous Sheaths of the Leaves and Coconut Cotton.—A brief reference has been made to these in an early part of this article. The finer ones are used as filters and sieves, but the coarser are apparently put to no purpose, although they have been proposed as suitable for paper-making. They might be used to strengthen saddlery, and even for ladies' corsets and splints. Knox says of Ceylon that "the filaments at the bottom of the stem of the coconut may be manufactured into a coarse cloth called *gunny*, which is used for bags and similar purposes."

On the young sheaths and petioles a brown-coloured cotton or tomentum will be seen similar to that already described under *Borassus flabelliformis* (B. 680). This is sometimes collected and used by the natives to stop bleeding from wounds. A good sample of it was shown at the Colonial and Indian Exhibition.

Cadjans.—The leaves are plaited into mats and screens and also made into baskets, and combs are said to be made of the midrib of the leaflets in the Friendly Islands. In the Laccadive Islands mats are made of the coconut leaf. These mats are of fine quality and much esteemed when exported. In the Islands they are employed for the sails of the smaller boats. "The Sinhalese split the fronds in halves, and plait the leaflets neatly, so as to make excellent baskets, and under the name of *cadjans* they form the usual covering for their huts, as well as of the bungalows of the Europeans." "The dead fronds are sometimes used as torches or for fuel; their midribs, tied together, are sometimes used as brooms for the decks of ships, as the fibres of the stalks are woody, brittle, and difficult to clean."—(*Royle*).

PALMS IN "CEYLON AND ITS CAPABILITIES."

By J. W. Bennett, F.L.S., 1834.

I.

Conflicting Descriptions of the Palms of Ceylon—Extraordinary Accounts of the process of Sura or Toddy Drawing—Classification and Description of the Coconut Tree—Process of Toddy Drawing, from Personal Observation—Sinnet for Sailors' Hats—Toddy, or Palm Wine—Varieties and Domestic Uses of the Cocos nucifera—Arrack—Oil—Vinegar—Jaggery—Native Method of Planting it, and their Superstition about Salt—Uses of the Fronds—Coconut Timber—Adhesive Properties of the Water of the Green Coconut—The Hiromane—Average Produce of a Coconut Tree—Uses of the Shells—Medicinal Oil from the bark—Medicinal Properties of the Root, Leaves, and Flowers—Extraordinary Notions about the Superabundance of the Coconut Palm, and Facility of Planting it—Coconut Oil Used in the Manufacture of Soap and Candles—Suggestions for extending the Culture of the Coconut Palm in the British West Indian and West African Colonies.

So many conflicting and erroneous accounts have been given of the palms of Ceylon, in travels and extracts from the travels of various writers, that if I were not satisfied to the contrary, I might be disposed to think the authors endeavoured to mislead, instead of inform, their readers; and if the former will be governed by *native* state-

ments only, instead of witnessing the processes which they pretend to describe, one cannot expect that the latter, how muchsoever they may be amused, will be enlightened by accounts at variance with facts. The subjoined notes* from the works of authors who have obtained general credence for the correctness of their representations, are (as all who have really witnessed the tedious process of preparing the coconut tree for the production of toddy will admit) absolute illusions.

Let it be supposed, for instance, that a planter in the West Indies, (where toddy drawing was, some few years ago, and probably continues to be, entirely unknown,) being desirous of testing these plans, adopted either one or all of them; and let his disappointment be imagined, when, anxiously anticipating the assured morning's draught of the "Palm wine of the poets," he found it altogether Eutopian! and if either of these incisive measures had been resorted to, and the pot hung up at the times these accounts were written, the authors would have waited a long time for their toddy; for it would not, even yet, after an interval of so many years, have begun to distil. I will, therefore, briefly describe the various natural properties and domestic usefulness of this splendid palm, from my own personal observation. The Coconut palm (*Cocos nucifera*, L., and *Polgaha* of the Sinhalese, Class XXI. *Monœcia*, Order VI. *Hexandria*, Natural Order *Palmæ*,) delights in a sandy soil, and the nearer to the margin of the sea, the quicker its growth, and more abundant its produce. It requires little or no care, beyond being well fenced from the inroads of cattle, for, fanned by the winds of the Indian ocean, it gains fecundity by exposure; and although its general height is from sixty to eighty feet it is not uncommon for it to exceed a hundred. Its diameter, at the base, is from two or three feet; and the root, which is composed of strong flexible fibres, about the thickness of a small rattan cane (*Calamus Rotang*, L.), spreads in a circle, and of these, some run to a great depth, and others creep along the surface of the soil. One may imagine a beautiful and verdant circle; formed of feathery fronds, from fourteen to sixteen feet in length, radiating from a common centre at the top of a tapering stem eighty feet in height, and that will afford some idea of the magnificence of the coconut palm.

The fronds are supported at the base by diagonal horizontal layers of strong elastic fibres, capable of sustaining great weight, and so closely united as to form, when gently stretched, an excellent substitute for a hair sieve for straining liquids. This fibrous support lies in *laminæ* between the branches, which it envelopes, as well as the incipient ones even to their rudiments, or what is commonly called the *cabbage*, and seems providentially adapted for the security of the passing traveller from the constant danger that would otherwise attend him, whilst traversing the coconut topes, from the sudden falling of decayed branches

* "Toddy is the juice running from an incision made in the stem of the leaves; and constitutes a very pleasant beverage when first gathered in."—*Statham's Indian Recollections*, page 29.

"A pot sufficient to hold two quarts is fixed to a shoot where an incision is made in the evening, and is brought down full at sunrise in the morning."—*Cordiner's Ceylon*, vol. i., page 352.

"A small incision being made, there oozes in gentle drops a cool pleasant liquor, called *tarce or toddy*, the palm wine of the poets."—*Forbes's Oriental Memoirs*, page 21.

"Toddy is procured by incision. It is only necessary to make a slit in the top of the tree, where the leaves shoot up, with a knife over night, and suspend a chatty, or earthen pot, from the branches so as to receive the juice, which immediately begins to distil, and continues to do so till next morning, when the pot is removed."—*Percival's Ceylon.*

"Between the cabbage like shoot and the leaves, there spring several buds, from which, on making an incision, there distils a juice differing little from water in color or consistence. This liquor is sold in the bazaars by the natives under the name of toddy."—*Tennent's Indian Recreations*, vol. ii., page 328.

See also Kerr's Voyages, vol. vii., p. 176; and Pennant's Hindustan, vol. i., p. 139

which its very firm adhesion to the trunk prevents: but it is not made into gummy bags, (*Gungeszaken* of the Dutch), as some authors have stated, and is merely used for straining toddy and other liquids, and for kindling fires. During the many years that I resided in Ceylon, I never heard of but one fatal accident from the falling of a coconut; a remarkable circumstance, when one considers the many fhousands of people constantly passing and repassing through the topes.*

Trees, intended for toddy drawing, are prevented from producing fruit by the following process. The toddy drawer first ties the spathe in three places, with strips of the tough white *pinnæ*† of the young fronds; which latter shoot perpendicularly at first, and are then of a beautiful white, but soon change to a straw color; these are concave towards the heart of the crest, and when they are successively forced from their position by new fronds, they gradually expand their pinnated leaves, and ultimately become horizontal. The old fronds have a strong mid-rib, with the footstalks nearest the tree proportionally thick; these embrace the stem, and as they gradually fall off, after hanging for weeks together by their fibrous support, or are pulled down for fuel, torches‡ and fences, they leave successive and very visible scars.

The purpose of tying the spathe is to prevent its expansion; it is then cut transversely, the extent of about two inches from the point, and beaten with an ebony or iron-wood baton, by the toddy drawer, for five or six mornings and evenings successively. The next operation is to remove a portion of the footstalk of the spathe, so as to admit of its depression, for the juice to flow freely, and it is kept in that position by attaching it to an inferior branch; in the course of five or six days, the toddy drawer suspends a calabash or earthern pot, called a *chatty*, from the decapitated spathe so as to receive the juice as it exudes from the flower, and this he repeats every morning and evening, taking off a slice of the flower as occasion requires, whilst any part of it remains. This delicious liquid, combining a pleasant but slight degree of sweetness with still less degree of acidity when fresh and of peculiar flavour, is called by us toddy; *Ra*, by the Sinhalese; and *Suri or Sura*,§ (which means palm wine,) by the Hindoos and Hindo-Portuguese; and being esteemed a gentle aperient, it is very often resorted to at the earliest peep of dawn, by the *bon-vivant*, by way of removing the unpleasant effects of more potent libations over night.

There are five varieties of this palm in Ceylon, and the grounds adjoining the Buddha temples generally contain the best specimens of the indigenous species. The priests readily afford strangers every information, but only upon inquiry, for their diffidence, which arises from the dread of

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* An Indian name for groves. In Bengal mango plantations are called *topes*, as well as those of the coconut tree; but where groves of palms are reserved for toddy drawing, they are called *toddy topes*.

† These are in general request by sailors in India for making hats. Jack first reduces the pinnæ into very narrow strips, then plants them into what he calls *sinnet* and, with a needle and thread, soon forms a good but heavy substitute for a chip hat; for it wears remarkably well, and being cooler than one of glazed leather, is better for inter-tropical service. Of the mid-rib (*costa*) the natives make neat whisks and bird cages.

‡ *Chulos*, and, (Anglice, *Chules*.) These the natives make, by laying down the pinnæ horizontally from the footstalk towards the point; but they leave one or two, at certain distances, in their natural position, for the purpose of tying the others round the mid-rib, or rather, the longitudinal section of it for each frond makes two chules.

§ "The word *Sura* in Sanskrit signifies both wine and true wealth; hence in the first *C'hand* of the *Ramayan* of *Valmic*, it is expressly said that the *Devatas* having received the *Sura*, acquired the title of *Suras*, and the *Daityas* that of *Asura*, from not having received it. The *Veda* is represented as that wine and true wealth; and the *Devatas* as enjoying it, in a superior degree, being termed as *Suras*, the prince, or supreme leader of the *Sura*, became, in the Grecian deity Baccaus, (by a confined translation of the word) the god of wine and drunkards,"—*Asiatic Researches*, vol. viii, page 50.

being considered obtrusive, does not proceed from disinclination to gratify the curiosity of the European visitor; and without *asking* for information when required, one may remain all one's life time in Ceylon and know no more of the varieties of the coconut palm than casual observation might suggest, from the mere circumstance of the difference in point of color of the nuts, from the *Kuroomba*, or water coconut, to that which approaches, or has attained maturity. The peculiar shape and bright orange colour of the *King coconut* cannot fail to attract observation, but it is scarcely even to be seen in the bazaars. It is occasionally presented by the priests or headmen, by way of compliment, to Europeans.

The next in beauty is of an orange color, but not of the beautiful pear shape of the king coconut. The third is of a pale yellow, rather cordiform, and the fleshy substance of its husk, which is between the epidermis and the nut, is edible in its green state. The fourth is the common coconut which is abundantly imported into this country from the West Indies: and the fifth is a sort of Maldive* or dwarf coconut, about the size of a duck's egg; this is esteemed as a rarity. I have remarked the coconut palm, in its various stages, in many countries; namely, the Azores, West Indies, Mauritius, Coast of Coromandel, Bengal, Penang, Malacca, Moluccas, Banda Islands, Celebes, and Timor; but I never saw it attain the height that it does in Ceylon. The finest arrack in the world is distilled by the Sinhalese from the fermenting toddy, (which, owing to the rapidity of that process, becomes an intoxicating beverage in the course of a few hours), and not from sweet toddy, as some travellers have erroneously asserted. One hundred gallons produce, by the simple chemical process of the Sinhalese, twenty-five of arrack *Polwakere*† which, when very new, is injurious to the constitution, but gradually acquires wholesomeness by age. Toddy is also used by bread bakers for the purpose of yeast.

Pine apples, steeped in arrack, impart a delicious flavor, and reduce its strength to that of a liqueur, unrivalled for making nectarial punch, or *Puntjee* of Hindus, meaning five:—thus our compound of sugar, lime juice, spirit, water, and lemon-peel, derives its English name from a Hindu numeral. Lamp oil is made from the kernel of the ripe coconut, after it has been exposed to the sun on mats until it has become rancid and discolored, (in which state the natives call it *Kopperah*,) by means of a simple press turned by bullocks; and oil for culinary purposes, by boiling the fresh pulp, and skimming it as it rises. The former is now made into candles and soap, and the oil-cake, or *poonac*, is used for feeding cattle and poultry. Vinegar is made by putting toddy, drawn in dry weather, into jars, and keeping them closely covered, but exposed to the sun, for a month; the toddy is then strained, and replaced in the same jars, with a little bird pepper (*Capsicum furtescens*, L.), a small piece of the red Ghorkah (*Cambogia gutta*), and of Moringa pod (*Hyperanthera moringa*), the jars are then laid in the earth for a month or five weeks, and thus a very excellent vinegar is produced.

Jaggery, a sort of sugar, is made by suspending a clean and dry calabash or chatty, instead of one in common use for toddy drawing, and containing some chips of the bark of the *Shorea robusta*, (*Halgas* of the Sinhalese,) which will cause the toddy to become sweet. Eight gallons of it boiled over a slow fire, yield two gallons of syrup, called in Sinhalese *Penni*; which, being again boiled, produces a coarse brown sugar, called *Jaggery*; this is formed into cakes in bottoms of coconut shells, by way of moulds; which having been enveloped in pieces of dried plantain leaf, are hardened, and preserved from humidity by being suspended where smoke has free access to them. A coconut tree,

* So called, because the Maldivian boats which visit the island bring a few extremely small nuts as curiosities.

† Batavian arrack is distilled from rice.

planted near the sea, generally blossoms in the fourth or fifth year; but in elevated situations of the interior, six or seven years may be considered the average period; and from that time to upwards of sixty years, this most prolific palm will continue to produce fruit in abundance, unless the tree be devoted entirely to the toddy-drawer, in which case it produces no fruit. The maturity of coconuts reserved for planting, is indicated by the brown colour of the husk; they are then plucked, and, having been laid aside for a few days, are ranged in rows, and, partly covered with earth; or as in many parts of the country, suspended from the branches of trees until vegetation has commenced. In about three months, more or less, the plant will have attained the height of sixteen or eighteen inches, and have thrown out three or four foliacious fronds. The best time for transplanting is during the rainy season, when the plants receive that abundant nourishment which their nature requires.

The Sinhalese are so extremely superstitious, that they invariably throw a little salt into holes, before they place the coconut plants in them; and they observe great regularity in forming their topes, by making holes for the plants in parallel lines, from twenty to twenty-four feet apart, about three feet deep, of the same diameter at the top, and in the shape of inverted cones, for the purpose of collecting the necessary moisture. If the salt were omitted, they would not expect the plant to flourish. The green fronds split, and their pinnated leaves interwoven, make covers for plants, baskets, and thatch; * and, when burnt, produce a superior alkali. The young *pinn* which are white and tough, make beautiful mats, baskets, and boxes for ladies' work. The stem is at first of a very spongy nature, and full of tough perpendicular and ligneous fibres; and until it is about twenty years old, is applicable only to the purposes of gutters, water pipes, and fences; but when it becomes old, it is fit for rafters, shingles, ornamental cabinet work, rice pounders, walking sticks, and for building country vessels, called *Dhonies* †. The water of the green coconut is a delicious drink, if it be plucked before sunrise: it is also used by house-plasterers, for its adhesive quality, in mixing their white and coloured washes, and, conjointly with jaggery and shell-lime, for stucco. The pulp of the young coconut is an admirable vegetable *Blancmange*: and the kernel of the seed coconut, after vegetation has commenced, is among the delicacies of a Sinhalese dessert. It is spongy, but pleasant to the taste, and greatly esteemed by the natives. The expressed juice of the pulp of the ripe nut is properly the milk, and is obtained by first rasping it with an instrument called *Hiramane* ‡ then soaking it in water and pressing it through a cloth, when it forms an ingredient in all good curries. The cabbage is delicious, whether fricasseed or picked, or in its raw state when it is as sweet and crisp as the Catappa almond (*Terminalia Catappa* L.)

A bunch of coconuts seldom exceeds fifteen or twenty good ones; and from trees growing in sandy situations, the fruit is gathered four or five times a year. The external husk, after having been soaked in water for a certain period, is beaten out into a fibre called *Koir* or *Koyar*, of which, yarn, ropes, cables, brooms, plasterers' brushes, bed and sofa mattresses, and bags, are manufactured. Coconut shells are made into cups, basins, lamps, sportsmen's liquor flasks, ladles, skimmers, spoons,

* Called by the natives, *Cajan*. † From 80 to 200 tons burthen.

‡ The *Hiramane* is the best kind of grater that can be employed to reduce the kernel for culinary purposes, because it obviates the necessity of breaking the nut-shell in pieces, or the previous removal of the kernel from it, which, in its ripe state, is no very easy matter. It consists of a circle of notched iron fastened to the end of a stout piece of wood, cut in a peculiar shape, which immemorial custom has induced the Sinhalese to consider the most convenient for this domestic purpose; and considered by Europeans to resemble a *boot jack*, but why, I have yet to learn.

lampblack, and charcoal ; which latter, when pulverized, forms an excellent dentifrice *. A powerful oil is extracted from the bark of the coconut tree, which is employed as a liniment in cutaneous diseases, and considered by the Sinhalese doctors eminently efficacious, provided that, in such cases a free use of the green coconut, as the principal article of diet, be strictly adhered to : and an ointment is prepared from the kernel, which is a certain cure for the ring-worm in children.

The root is considered by the native doctors so efficacious in intermittent and remittent fever, that it is almost invariably employed by them, Small pieces of it are boiled with dried ginger and jaggery, and the decocture is given to the patient at regular intervals. The same decocture, when used as a gargle, is mixed with the oil of the nut, freshly made, and generally affords considerable relief to the patient in cases where pustules have formed in the mouth or glands of the throat.

In hemorrhoids, the expressed juice of the leaves, mixed with fresh oil of the nut, and taken internally, is considered a sovereign remedy ; and in ophthalmic complaints the external application of the expressed juice of the nut, mixed with new milk from the cow or goat, mitigates, if it does not entirely remove, inflammation.

The juice of the flower is of so astringent a nature, that it has the same effect as a solution of alum upon the inside of the mouth ; this, mixed with new milk, and taken in small quantities, not exceeding a wine-glass-full but at regular periods, affords almost immediate temporary relief, and, if persevered in, effectual cure, in that most debilitating of diseases in tropical climates, *Lues Gonorrhœa*. The shade of the coconut tree is wholesome ; for wherever there are coconut topes, very little underwood is found. An odd notion has long prevailed, that if all the coconut trees in Ceylon were cut down, the natives would be obliged to cultivate the rice more extensively, and that it would operate as a general blessing ! ! To me it appears a subject of regret, that the many virtues of this invaluable palm, apparently bestowed by the hands of a beneficient Providence, for the use and happiness of the natives of tropical climates, are not more universally known and encouraged throughout the British West India Islands. Those whose duties may have called them, as in my own case, to both countries, cannot have failed to remark the apparently degenerated state of the coconut tree of the West Indies in comparison with that of the East †.

The facility of planting the coconut palm—the small portion of care requisite for its growth and preservation,—the multiplied benefits which in its maturity it bestows upon man,—all tend to render it an object of peculiar regard to those who are the guardians, deputed by the Giver of all good, of the labourer of the tropics.

The Sinhalese are very remarkable for their luxuriant and beautiful hair, and attribute it to the use of coconut oil, which, in a perfumed state, is also employed by Europeans ; but it is only by habitual use that its virtues can be sufficiently ascertained to insure its general adoption as a promoter and preserver of the hair, unless its natural properties are destroyed by adulteration : and as steam and other English oil-mils are now used, and the demand for coconut oil has generally increased, since its employment in the manufacture of candles and soap, it may be anticipated, that from the recent improvement of the quality of the coconut oil

* See page 103, Bennett's Ceylon for the Sinhalese musical instrument, the *rinah*.

† If the reader has not previously read "A Treatise upon the Coconut palm, by a Fellow of the Linnæan and Horticultural Societies," published in the year 1830, and a second edition of it, in my own name, in 1836, it will afford him some amusement to compare the former with the second volume of "Wanderings in New South Wales, Batavia, Pedir Coast, Singapore, and China by George Bennett, Esq., F.L.S., and Fellow of the Royal College of Surgeons," published by Mr. Bentley in 1834,) pages 297 to 335 inclusively

for table use, by its being rendered free from smoke, its importation will continue in an increasing ratio; and, consequently, too much attention and encouragement cannot be given to a more extensive cultivation of this invaluable palm not only in Ceylon, but throughout our West Indian and West African colonies.

Independently of the general consumption of the produce of the coconut palm by the native inhabitants, and its extensive employment in the most domestic economy of Europeans, it finds a ready market for exportation: and the manufacture of coir yarn, ropes and cables, oil, vinegar, arrack, jaggery, and cajans for thatching bungalows and native houses, affords employment to a considerable portion of the Sinhalese and Malabar population.

II.

The Areka Palm and its Linnæan Classification—Flower and Fruit used for Ornamenting Temporary Buildings for Festivals—Arekanut Antiscorbutic—Spathe and its Uses—Terra Japonica—Properties of the Arekanut as a Dye—Suggestions for Condensing the Dye—Heat Generated by the Nuts—Barter through the Agency of Buddhist Priests—Wood excellent for Bows—Palmyra (Borassus flabelliformis, L.) common in the Northern and Eastern Provinces—Buddhist Priests and their Fans—Native Books—Palm Oil—Kellingo—Palmyra Toddy and Jaggery—Timber and its principal Uses—Sugar Palm (Caryota urens, L.)—Kitul Fishing Rods—Sago—Elephant Bows and Snares or Nooses—Kitul Toddy and Jaggery—Hookhas—Calabashes—Sugar Palm chiefly cultivated in the Southern Province—Talipot Leaf—Its Uses—Conflicting Accounts of the Report caused by the Bursting of the Spathe of the Talipot Tree—Mabole—Talipot Sago—Talipot Palm at Colombo—Privileges of the Priests of Buddha—M. de la Loubere's Notice of the use of the Talipot Fan by the Priests of Siam—Talipot Plants sent to England by the Author—Tavelam Tents—Palms from Mauritius introduced into Ceylon—Phœnix sylvestris, L.—Dwarf Palm.

In a commercial point of view, the Areka palm (*Areka catechu*, L., Class *Monœcia*, Order *Monadelphia*, Natural Order *Palmæ*; *Puak-gaha* of the Sinhalese, *Faufel* of Bauhine, and *Pinanga* of Rumphius) is next in value to the coconut tree. The flower, which, like that of coconut palm, is white, is used conjointly with its beautiful drupes, and the flower and fruit of the coconut tree, and the wild flowers and moss (*Lycopodium zeylanicum*) with which the cinnamon gardens abound, in ornamenting temporary buildings for ball and other festivities.

This palm so greatly resembles the cabbage palm (*Areca oleracea*, L.) of the West Indies, that, upon a cursory view, it is scarcely to be distinguished from the latter except by its drupes. The heart of the crest of the *Areca catechu* is also edible: but it is both inferior to that of the cabbage and coconut palms. The drupes are about the size of a hen's egg,* with a smooth epidermis of a bright gold or orange colour, occasionally speckled with brown; these grow in clusters, like coconuts in miniature, but at the very base of the verdant crest, instead of between the fronds, as in the coconut palm. The average annual produce is from 280 to 300 nuts.

The nut forms a principal ingredient in the betel masticatory, so general throughout India and the Eastern Archipelago, where it is called *Paan* or *Pawn*, and is the first thing offered by way of compliment by natives of all classes. It is considered an anti-scorbutic for the teeth and gums, and to give the breath an aromatic odour; but its habitual use imparts an appearance of bleeding at the mouth, which is particularly disgusting in women. The pulverized charcoal of the nut forms an excellent dentifrice.

The fronds are more bushy in foliage than those of the coconut tree, and about half their length: they have also a strong mid-rib, but the leaflets are *folded back*, and being more irregular in shape, and thicker

* Described in the *Hortus Botanicus Americanus* as of the size of a *coconut*!!

than those of the coconut palm, cannot be interwoven into *Cajans*. The base of the crest, to the height of three feet, is enveloped in a sort of spathe, which the Sinhalese called *puakpatta*; this being extremely tough and elastic, is of great utility to the natives for domestic purposes particularly for carrying milk and oil, and their curry and rice, when travelling; but where the sugar palm (*Caryota urens*, L.) abounds, it is principally in request for the purpose of holding the *Kitul Penni*, or sweet syrup, and will retain its original elasticity for many years.

I have heard it asserted, that the extract of the arekanut is the *Terra Japonica* of commerce, and if a few of the nuts are boiled in water with a little chunam, the decoction has both the taste and odour of that drug; but if this be the case, its present name is greatly misapplied. The properties of the arekanut, as a dye, are well-known in Scotland; it is of a peculiar red, and cannot be mistaken by any one accustomed to the other. I should conceive it practicable to condense the dye, so as to save a great deal in freight, instead of exporting the nuts; and strong objections to their exportation to any great distance arises from the excessive heat which is generated by their stowage in bulk; this is perceptible even whilst lying in heaps for a few days before they are shipped.

The Ceylon areka tree is famous for the superior quality of its nut, which was always a great article of barter between the Kandyan inhabitants of Saffragam, and Barberyn, via Kalutara, long before our occupation of the interior. This traffic was chiefly carried on through the agency and connivance of the Buddhist priests, who allowed depôts of nuts to be formed at the various *Panselas** on each side of the Kalu-ganga, from whence they were conveyed away, in *Pardie*† boats, to the sea coast. The tree itself is beautiful, and delights in a sandy soil. The stem is slender and, with occasional exceptions, straight as an arrow to the height of seventy or eighty feet. Its circumference varies little throughout its length, seldom exceeding two feet at the base from which to the crest, the wood is as tough as whalebone, and the best in the word for bows and pingoes. There is a wild species of this palm (*Areca sylvestris*), which the Sinhalese call *Lenateri gaha*.

The third palm, in point of value for its domestic properties, is the fan palm, or palmyra (*Borassus flabelliformis*, L.) class XXII. Diœcia, and order VI, Hexandria. Sinhalese call it *Talgaha*. Linnæus describes the male tree by the Malabar name of *Ampana* and the female tree by that of *Carim-pana*. Male flower, *calyx*; universal *spathe*, compound; *spadix* amentaceous, imbricated; *corol* three-parted: *petals* egg'd concave; *stamens* filaments six, thickish, anthers thicker, striated. Female flower, *calyx*; *spathe* and *spadix* as in the male; *corol* three-parted; *petals* roundish, small permanent; *pistil*, germ roundish, styles three, small, stigmas simple; *pericarp*, drupe roundish, obtuse, rigid, one cell'd; *seeds* three, rather egg'd, compressed, distinct, filamentous. Like all the other palms, the fronds of the palmyra grow on the top of the tree only; but as these are cut down, or fall off, they leave their *vestigia* much more distinct than either of the other palms, and the bark is consequently so much rougher, that the tree may be ascended with less difficulty, by inexpert climbers, than either the coconut, areka, or sugar palms. The spathe resembles that of the *Areca Catechu* in toughness and elasticity, and is used by the natives for similar purposes. This tree is more common in the Northern and Eastern Provinces than in any other part of the island; and those that I have seen seldom exceeded thirty or forty feet in height. The fronds are fan-leaved, armed with spines, radiating from a common centre and the *Stipes* sawed at the edges. The fan-part is about four feet in diameter: the spines are cut off, and the middle is formed into fans, or

* Temporary residences for priests; derived from the Pali words *Pan*, leaf, and *sala*, shed. † Flat bottomed boats, iron fastened, and with sliding roofs, thatched with *Cajans*.

punkahs; these are lackered for sale, or used plain, as may suit the taste of the purchasers; but one never sees a Buddist priest without one of the smaller sort, or a fan of some kind or other; of which, some are heart-shaped, others circular, with handles of carved ivory.

I have heard many arguments as to the fan being an emblem of authority*; and some pretend that the degrees of the Buddist priesthood may be distinguished by their fans; but I do not state this as an ascertained fact, although I have myself observed that the handsomest *punkahs* are carried by the higher orders of the priesthood (†). Palmyra leaves are subdivided longitudinally into strips for native book and letters, and bear the general name of *Olas*. These are written upon with an iron style, and lampblack is then rubbed over the writing, which makes the characters more legible; this from the smoothness of the surface, is easily wiped off, leaving the part that is not impressed by the style perfectly clean. The fruit, which is a large three-seeded drupe, grows in bunches, and is much esteemed. Palm oil is made of the pulp after having been exposed to the sun and become rancid. The spring leaf, or *Kellingos*, is a most excellent vegetable, when boiled or fricasseed; this the natives manufacture into a nutritious meal, or flour of delicious flavour, by cutting it off close after the seed nuts have been sown a few months, then drying it in the sun, and afterwards pounding in a rice mortar. The Dutch formerly considered palmyra flour so very valuable as a convalescent diet, as well as for presents to their friends, that they often exported to the Cape of Good Hope and Holland:—in both places it was much esteemed, and used for thickening, and imparting its peculiar flavour to soups and made dishes. Palmyra toddy is drawn from the flower, and good *Jaggery* is made from it by a similar process to that prescribed in the preceding pages. On the outside and at the base of the fronds, just where they rise from the stem, there is a soft cotton-like substance, of a light brown color, which is collected and employed by the native doctors for staunching blood or hemorrhage. The timber, being dark and beautifully striated, is very much esteemed for cabinet work; and by builders for rafters, &c. It is extremely durable, becoming harder and tougher with age.

The net of the indigenous palms, in point of domestic utility, is the sugar palm (*Caryota urens*, L.) or *Kitul Gaha* of the Sinhalese, of class XXI. Monœcia, and order VIII. Polyandria. Male flower *calyx*; universal *spathe*, compound; *spadix* branchy: *corol* three-parted; *petals* lanced, concave; *stamens*, filaments many, rather longer than the corol; *anthers* linear. Female flower upon the same *spadix* with the male ones, *calyx* common with the males; *corol* three-parted; *petals* pointed, very small; *pistil*, germ roundish; *style* pointed; *stigma* simple; *pericarp*, a berry, a roundish, one cell'd; *seeds*, two, large, oblong, roundish on one side, flat on the other. The berries are about two and a half or three inches in circumference, and are thickly studded upon dependent stems, from four to five feet in length, and about three feet in circumference, like a mass of closely knotted ropes, diverging from a common centre: these, when ripe, are of a brilliant red colour, from which the *trivial* name of this palm is derived. The tree is straight in growth, and without fronds except at the top where they form a dark green crest but are different to those of the other indigenous palms, being *twice-feather-leaved*; and the leaflets are of triangular shape. The transverse division of the fronds are much esteemed by the native fishers for angling rods.

The *Kitul* seldom exceeds forty feet in height. The petioles leave their annular *vestigia* upon the bark, like those of the coconut and areka palms. The pith produces a nutritious sago; but, according to my humble judgment.

(*) St. Mathew particularly alludes to the fan or (winnow) in his 3rd chapter, verse 12.

(†) *Maha Nayaka Unnanse* signifies a high priest., and *Unnanse* a priest.—*Gane-nanse* a teacher, aud *Therunnanse* a reader.

it is very inferior to the brown sago of the Moluccas, or the white sort of China. The wood, when very old, is tough and heavy, and is made into rice pounders, bows* and pingoes for carrying burthens. The outer cuticle is so very strong and elastic that the natives make it into nooses and ropes for securing elephants. The toddy, which is also drawn from the flower, is so very luscious, that it is only drunk when that from the coconut tree cannot be readily procured. Eight gallons of this liquid, boiled over a slow fire, will produce four gallons of a very thick syrup, called *Kitul Penni*; to this also added small pieces of the bark of the *Hagas* (*Shorea robusta*), and being again boiled, double the quantity of *Jaggery*, and of a superior quality to that from the coconut palm, is the product. The Kandyan *Jaggery* is made entirely from this syrup, and will keep good for several years. Although the common sort is of the color of the coarser Muscovado sugar, a finer sort, of very superior quality, and the best substitute that can be obtained for Chinese sugar-candy, which it greatly resembles, is made for headmen. *Jaggery* is a principal ingredient in the *Chillum* used throughout India by *Hookah*, *Gur-Gurree and Hubble-bubble* smokers. Clean chatties or calabashes are indispensable for collecting *sweet* toddy which would otherwise be affected by the acidity inseparable from using the same vessel twice, without being well washed and dried. The Ceylon calabash is a gourd (*Cucurbita lagenaria*, L.); that of the West Indies is the fruit of the calabash tree (*Crescentia cujete*, L.), which is not produced in Ceylon.

The *Jaggery*, or sugar makers, are called *Hakooroos* and toddy drawers and *Chandoos*; but both are included in the subdivisions of the same caste (*Sudra Wanse*), the second in rank of the principal Sinhalese castes. Each cake of *Jaggery* is separately enveloped in a piece of the dried leaf of the plantain (*Musa sapientum*, L.), or banana (*Musa paradisiaca*, L.) and then suspended where smoke has free access to it, until required for the market or other purposes. The shape and size of a cake of common *Jaggery* is that of the bun of our English pastry cooks. The *Kitul* tree is more extensively cultivated in Saffragam, in the Southern Province, than in any other.

The next in value, but the most magnificent of Ceylon palms in appearance, is the talipot or umbrella-bearing palm (*Corypha umbraculifera*, L.); the *Licuala spinosa* of Thunberg, and *Talagaha* of the Sinhalese. Its classification has for many years been in a most undecided state. Thunberg describes the flower as follows,—*Calyx*; *perianth* one-leaved three-parted, hairy within; *corol* three-parted almost to the base, the divisions egg'd acute, concave; *nectary* garland form, twice as short as the corol; *stamen*, filaments six, inserted in to the nectaries, erect, very short; *anthers* oblong, twin; *pistil*, germ above, convex, furrowed, three-parted smooth; *style* one, simple; *stigmas* two. The talipot leaf is the largest known; it is circular, feather handled, folded, and intercepted with a thread. The natives subdivide it into eight parts, and these are sewed at the side with the natural thread, and ornamented with talc and various colors for the use of headmen. Its circumference is from thirty to forty feet; and it is so thoroughly impervious to the sun and impenetrable by the heaviest rains, that its value to the native traveller may be easily imagined. The most valuable of the Sinhalese books are formed of strips of the leaf; these are engraved with an iron style, and some now extant, although written many centuries back, have all their original freshness of appearance. Tents of all forms and sizes are also made of the leaf, supported by bamboo poles, than which nothing can be lighter for carriage or better for the purpose of temporary shelter.

One of the specimens of the talipot leaf that I brought with me from Ceylon, which measures thirty-six feet in circumference, may be seen in the Museum of King's College, with my name attached to it; but *how* it

* The elephants bows used by the natives of the Mahagampattu, in the Southern Province, are made of this wood, and tempered in the smoke of wetted rice straw, thrown upon a fire made of jungle leaves.

got there I have yet to learn. It is, however, most satisfactory to know that it is so well disposed of. The fate of the others is still a mystery : for although they were borrowed to be shown at certain scientific institutions, neither of them have found their way back to the proper owner for the last fourteen years. There have been many conflicting statements published of this palm ; and although I never was within view of a talipot tree at the moment of its spadix bursting the spathe, it has been stated in one of the " Annuals " that I had witnessed it several times. This perhaps was not the first, nor has been the last, of the same author's *mistakes* ; but I am not at all disposed, because I was not present, to dispute the native accounts of the loud report, with which the bursting of the talipot's compound spathe is accompanied, until it be refuted by some individual of unimpeachable veracity, who may have been *near the tree* at the time of its taking place,—feeling satisfied, notwithstanding the opinions as to its gradual expansion, that in calm weather it may be heard at a considerable distance ; for I was positively assured by several respectable Dutch inhabitants at Grand Pass, as well as by two intelligent Malays, who had resided for a considerable time at Matale, now part of the Central Province, where the *Talgaha* abounds, that the bursting of the spathe is attended with a loud report.

The natives entertain a similar belief to that commonly entertained of the American aloe, that the talipot lives a century before it blossoms ; but it is too well known that the growth of all the palm family is extremely rapid and moreover that the heart of the talipot stem consists of a spongy fibre for this part of its description to be credited. In 1822, a talipot palm blossomed at Mabole, about six miles to the northward of Colombo ; and for nearly three months, viz., from the time of the spadix bursting its spathe to the flower attaining its full height, (nearly thirty feet), and for a further space of four months before it seeded, the road was occasionally thronged with the curious, among them the " evening beauties " of the Pettah, on their way to view this wonder of the vegetable world ere its floral magnificence departed. Sago is prepared from the granulated pith of the talipot palm, which some consider equal to the tree sago of the Moluccas ; but if I may judge from the specimen that I brought with me to this country, it is even inferior to that of the *Caryota urens*, or *Cycas circinalis*. There are very few objects in the vegetable kingdom more beautiful or remarkable than this palm, or more useful to the countries where it is indigenous. There is a beautiful specimen of it in the compound of the Kachcheri at Colombo, where the casual visitor who may not have time or opportunity for seeing it in the interior, may gratify a very commendable curiosity.

The Buddhist priests had a same privilege as Royalty, in the reign of the late King, as to the talipot fan being borne over them with the broad end foremost ; and M. de la Loubère, in his account of Siam, in alluding to the priests of Buddah, particularly mentions the talipot fan, " Pour se garantir du soleil, ils ont le talipat qui est leur parasol en forme d'ecran." In 1822 and 1825 I sent several talipot plants to the late Earl of Takerville, Lord Bagot, and the Horticultural Society of London, from Ceylon ; and in 1839, I presented the only perfect talipot seed that I had left to Mr. James Carter, the eminent seeds man of High Holborde. Be the quantity of rain what it may, not a particle of moisture is imbibed by the talipot leaf; and, exclusively of the uses made of it by all classes of the natives, as a defence from sun and rain, the Tavelam (*s*) people employ it for tents to cover their bags of salt on their journeys from the coast to the interior. A Tavelam *bivouac* is by no means an uninteresting sight to an European. Bags of salt are piled together, and the pointed ends of the segment of the talipot leaf are laid on the uppermost bag, so as to radiate from the centre by means of a heavy weight, which keeps them in that position ; and, by means of *koir* or jungle lines and pegs the whole are kept in a circular shape, like a bell-tent, and afford a sufficient covered space around

the salt bags, by way of verandah, for the traders and drovers to cook their victuals and take repose.

During my stay at Geduit, the Governor's country house at Mauritius in 1821, I availed myself of his Excellency's (the late lamented Sir Robert Townshend Farquhar, Bart, K.S.L.) kind permission to select whatever plants I pleased from the Government Garden; and amongst very many others, I took two of the date palm (*Phœnix dactylifera*, L.), and two of the *Cycas circinalis* L., to Ceylon; both the former died, but one of the latter, which I planted at Bagatelle near Colombo was a very fine tree when I left the island, and the other was transferred by the late Honorable the Chief Justice, Sir Hardinge Giffard to whom I had given it, to the Royal Botanic Garden at Peradeniya, near Kandy, where it flourished as well as in its natural soil. Although Ceylon does not produce the date palm there is no reason why it should not, for two wild varieties of that palm (*Phœnix sylvestris*), called by the Sinhalese *Indi* and *Mahindi*, are plentiful enough and well adapted for fences owing to their extremely strong and sharp spines. The drupe, which is rather more oblong, but not larger than a common Bullace plum (*Prunus insitilia*, L.), is a purplish black, insipidly sweet. There is also an indigenous species of dwarf palm or palmetto (*Chamerops*, L.), Class *Polygamia*, Order *Diœcia*, Natural Order *Palmæ*, of which small baskets (*Hewbili*) are made, the only purpose to which its leaves are applied.

COCONUT PALM.

Cocos Nucifera, Linnæus.

(*From "Origin of Cultivated Plants," by Alphonse de Candolle, 1885.*)

The coconut palm is, of all tropical trees, the one which yields the greatest variety of products. Its wood and fibres are utilized in various ways. The sap extracted from the inner part of the inflorescence yields a much-prized alcoholic drink. The shell of the nut forms a vessel, the milk of the half-ripe fruit is a pleasant drink, and the nut itself contains a great deal of oil. It is not surprising that so valuable a tree has been a good deal planted and transported. Besides, its dispersion is added by natural causes. The woody shell and fibrous envelope of the nut enable it to float in salt water without injury to the germ. Hence the possibility of its transportation to great distances by currents and its naturalization on coasts where the temperature is favourable. Unfortunately, this tree requires a warm, damp climate, such as exists only in the tropics, or in exceptional localities just without them. Nor does it thrive at a distance from the sea.

The coconut abounds on the littoral of the warm regions of Asia, of the islands to the south of this continent, and in analogous regions of Africa and America; but it may be asserted that it dates in Brazil, the West Indies, and the west coast of Africa from an introduction which took place about three centuries ago. Piso and Marcgraf* seem to admit that the species is foreign to Brazil without saying so positively. De Martius,† who has published a very important work on the Palmaceæ, and has travelled through the provinces of Bahia, Pernambuco, and others, where the coconut abounds, does not say that it is wild. It was introduced into Guiana by missionaries.‡ Sloane § says it is an exotic in the West Indies. An old author of the sixteenth century, Martyr, whom he quotes.

* Piso, *Brasil.*, p. 65: Marcgraf, p. 138.

† Martius, *Hist, Nat, Palmarum,* 3 vols. in folio: see vol. ii. p. 125.

‡ Aublet. *Guyane*, suppl., p. 102.

§ Sloane, *Jamaica*, ii. p. 9.

speaks of its introduction. This probably took place a few years after the discovery of America, for Joseph Acosta * saw the coconut palm at Port Rico in the sixteenth century. De Martius says that the Portuguese introduced it on the coast of Guiana. Many travellers do not even mention it in this region, where it is apparently of no great importance. More common in Madagascar and on the east coast, it is not, however, named in several works on the plants of Zanzibar, the Seychelles, Mauritius, etc., perhaps because it is considered as cultivated in these parts.

Evidently the species is not of African origin, nor of the eastern part of tropical America. Eliminating these countries, there remain western tropical America, the islands of the Pacific, the Indian Archipelago, and the south of Asia, where the tree abounds with every appearance of being more or less wild and long established.

The Navigators Dampier and Vancouver † found it at the beginning of the seventeenth century, forming woods in the islands near Panama, not on the mainland, and in the isle of Cocos, situated at three hundred miles from the continent in the Pacific. At that time these islands were uninhabited. Later, the coconut palm was found on the western coast from Mexico to Peru, but usually authors do not say that it was wild, excepting Seeman,‡ however, who saw this palm both wild and cultivated on the Isthmus of Panama. According to Hernandez § in the sixteenth century, the Mexicans called it *Coyolli*, a word which does not seem to be native.

Oviedo ‖ writing in 1526, in the first year of the conquest of Mexico says that the coconut palm was abundant on the coast of the Pacific in the province of the Cacique Chiman, and he clearly describes the species. This does not prove the tree to be wild. In southern Asia, especially in the islands, the coconut is both wild and cultivated. The smaller the islands, and the lower and the more subject to the influence of the sea air, the more the coconut predominates and attracts the attention of the travellers. Some take their name from the tree, among others two islands close to the Andamans and one near Sumatra.

The Coconut occurring with every appearance of an ancient wilp condition at once in Asia, and western America, the question of origin is obscure. Excellent authors have solved it differently. De Martius believes it to have been transported by currents from the islands situated to the west of Central America, into those of the Asiatic Archipelago. I formerly inclined to the same hypothesis, ¶ since admitted without question by Grisebach ; ** but the botanists of the seventeenth century often regarded the species as Asiatic, and Seemann, †† after a careful examination, says he cannot come to a decision. I will give the reasons for and again each hypothesis

In favour of an American origin, it may be said:—

1. The eleven other species of the genus Cocos are American, and all those which De Martius knew well are Brazilian, ‡‡ Drude §§ who

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* J. Acosta, *Hist. Nat. des Indes*, French trans, 1598, p. 178.

† Vater, *Voyage de Dampier*, edit. 1705, p. 186 : Vancouver, French edit., p. 325, quoted by de Martius, *Hist. Nat. Palmarum*, i. p. 188.

‡ Seemann, *Bot. of Herald*, p. 204.

§ Hernandez, *Thesaurus Mexic.*, p. 71. He attributes the same name p. 75, to the coconut palm of the Philippine Islands.

‖ Oviedo, Ramusio's trans., iii. p. 53.

¶ A. de Candolle, *Geogr. Bot. Raisonnee* p. 976.

** Grisebach, *Vegetation de Erde*, pp. 11. 323.

†† Seemann, *Flora Vitiensis*, p. 275.

‡‡ The coconut called Maldive belongs to the genus Lodoicea: Coco *mamillaris*. Blanco, of the Philippines is a variety of the cultivated Coco *nucifera*.

§§ Drude, in *Bot. Zeitung*, 1876, p. 801 ; and *Flora Brasiliensis*, fasc. 85, p. 405.

has studied the Palmaceæ, has written a paper to show that each genus of this family is proper to the ancient or to the new world, excepting the genus Elæis and even here he suspects a transport of the *E. guineensis* from America into Africa, which is not at all probable. The force of this argument is somewhat diminished by the circumstance that *Cocos nucifera* is a tree which grows on the littoral and in damp places, while the other species live under different conditions frequently far fromt he sea and from rivers. Maritime plants, and those which grow in marshes or damp places, have commonly a more vast habitation than others of the same genus.

2. The trade winds of the Pacific, to the south and yet more to the north of the equator, drive floating bodies from America to Asia, a direction contrary to that of the general currents.* It is known, moreover, from the unexpected arrival of bottles containing papers on different coasts, that chance has much to do with these transports.

The arguments in favour of an Asiatic, or contrary to an American origin, are the following:—

1. A current between the third and fifth parallels, north latitude, flows from the islands of the Indian Archipelago to Panama.† To the north and south of this are currents which take the opposite direction, but they start from regions too cold for the coconut, and do not touch Central America, where it is supposed to have been long indigenous.

2. The inhabitants of islands of Asia were far bolder navigators than the American Indians. It is very possible that canoes from the Asiatic Islands, containing a provision of coconuts, were thrown by tempests or false manœuvres on to the islands or the west coast of America. The converse is highly improbable.

3. The area for three centuries has been much vaster in Asia than in America, and the difference was yet more considerable before that epoch, for we know that the coconut has not long existed in the east of tropical America.

4. The inhabitants of the island of Asia possess an immense number of varieties of the tree, which points to a very ancient cultivation. Blume, in his *Rumphia*, enumerates eighteen varieties in Java and the adjacent islands, and thirty-nine in the Philippines. Nothing similar has been observed in America.

5. The uses of the coconut are more varied and more habitual in Asia. The natives of America hardly utilize it except for the contents of the nut, from which they do not extract the oil.

6. The common names, very numerous and original in Asia, as we shall presently see, are rare, and often of European orgin in America.

7. It is not probable that the ancient Mexicans and inhabitants of Central America would have neglected to spread the coconut in several directions, had it existed among them from a very remote epoch. The trifling breadth of the Isthmus of Panama would have facilitated the transport from one coast to the other, and the species would soon have been established in the West Indies, at Guiana, etc., as it has become naturalized in Jamaica, Antigua,‡ and elsewhere, since the discovery of America.

* Stieler, *Hand Atlas*, edit. 1867, map 3.

† Stieler, *ibit*, map, 9.

‡ Grisebach, *Flora of Brit. W. Indies*, p. 552.

8. If the coconut in America dated from a geological epoch more ancient than the pleiocene or even eocene deposits in Europe, it would probably have been found on both coasts, and the islands to the east and west equally.

9. We cannot find any ancient date of the existence of the coconut in America, but its presence in Asia three or four thousand years ago is proved by several Sanskrit names. Piddington in his index only quotes one *Narikela*. It is the most certain, since it recurs in modern Indian languages. Scholars count ten of these, which, according to their meaning, seem to apply to the species or its fruit* *Narikela* has passed with modification into Arabic and Persian.† It is even found at Otahiti in the form *ari* or *haari*‡ together with a Malay name.

The Malays have a name widely diffused in the archipelago—*kâlapa, klâpa, klôpo*. At Sumatra and Nicobar we find the name *njíor, nieor*; in the Philippines, *niog*; at Bali *niuh, njo:* at Tahiti. *niuh*; and in other islands, *nu, nidju, ni*; even at Madagascar, *wua-niu*.§ The Chinese have *ye*, or *ye-tsu* (the tree is *ye*). With the principal Sanskrit name this constitutes four different roots, which show an ancient existence in Asia. However, the uniformity of nomenclature in the archipelago as far as Tahiti and Madagascar indicates a transport by human agency since the existence of known languages.

The Chinese name means head of the king of Yuë, referring to an absurd legend of which Dr. Bretschneider speaks. This savant tells us that the first mention of the coconut occurs in a poem of the second century before Christ, but the most unmistakable descriptions are in works later than the ninth century of our era. It is true that the ancient writers scarcely knew the south of China, the only part of the empire where the coconut palm can live.

In spite of the Sanskrit names, the existence of the coconut in Ceylon, where it is well established on the coast, dates from an almost historical epoch. Near Point-de-Galle, Seemann tells us, may be seen carved upon a rock the figure of a native prince Kotah Raya, [Kusta Raja] to whom is attributed the discovery of the uses of the coconut, unknown before him; and the earliest chronicle of Ceylon, the *Mahawansa*, does not mention this tree, although it carefully reports the fruits imported by different. princes. It is also noteworthy that the ancient Greeks and Egyptians only knew the coconut at a late epoch as an Indian curiosity. Apollonius of Tyana saw this palm in Hindustan, at the beginning of the Christian era.

From these facts the most ancient habitation in Asia would be in the Archipelago, rather than on the continent or in Ceylon, and in America in the islands west of Panama. What are we to think of this varied and contradictory evidence? I formerly thought the arguments in favour of Western America were the strongest. Now with more information and greater experience in similar questions, I incline to the idea of an origin in the Indian Archipelago. The extension towards China, Ceylon, and India dates from not more than three thousand or four thousand years ago, but the transport by sea to the coasts of America and Africa took place perhaps in a more remote epoch, although posterior to those epochs when the geographical and physical conditions were different to those of our day.

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* Eugene, Fournier has indicated to me, for instance, *dradupala* (with hard fruit) *pulakecara* (with hairy fruit), *jalakajka* (water holder,) etc.

† Blume, *Rumphia*, iii. p. 82.

‡ Forest, *De Plantis Esculentis*. p. 48; Nadeaud, *Enum. des Plantes de Taiti*, p. 11

§ Blume, *ubi supra*.

COCONUT CULTIVATION AND MANUFACTURE OF THE OIL IN SOUTHERN INDIA AND CEYLON:

WHY SHOULD COCHIN OIL SELL 36 PER CENT BETTER THAN CEYLON? HOW TO IMPROVE THE CEYLON COPRA.

WHITE COCONUT OIL.

(*From the Ceylon Observer*, 30th October, 1897.)

A most practical question, and one that has been far too long neglected, is raised in the enquiry with which we head our remarks. Can there be any permanent unchangeable reason why "Cochin" coconut oil should fetch, on an average, 36 per cent. more value in the London market than the coconut oil from Ceylon? Cochin is three degrees farther from the equator than Colombo; but in most respects must have a climate and soil very similar to that of our West Coast, save that its dry season is said to be longer. Applying to a Colombo friend with prolonged experience, for an explanation, we have been favoured with the following interesting remarks:—

"The superiority of Cochin coconut oil over Ceylon oil is due to the superior whiteness and quality generally of the Cochin copra as compared with Ceylon copra. Although the S.-W. monsoon rains from end of May to August are very heavy in the Cochin State, there is a larger number of dry months than in Ceylon, and it is in these dry months that the coconut kernels are dried in the sun only, which gives a whiter and better copra than the average of Ceylon, and as Cochin oil is made from this whiter copra, this accounts for its superiority. It is not supposed that the Cochin coconuts are practically better than Ceylon nuts, but that the superiority of the Cochin oil may be attributed solely to the better climate, and to the superiority of the preparation of the copra from which the oil is made. Cochin oil is believed to contain a larger portion of stearine than Ceylon oil, and hence its special suitableness for the manufacture of fine candles such as those made by Price's Patent Candle Company, which are so well and favourably known to the public."

We give next an interesting communication,—which, in reality, prompted our enquiry—that reached us by a recent mail from a very old Colombo merchant long retired from the Island: we have filled in the figures of rainfall and temperature for our West Coast as desired by him. He writes as follows:—

"Has the question ever been raised and discussed wherefore there should exist such a material difference in the value in Europe between Ceylon coconut oil and the oil shipped from the Western Coast of India?* It is quite worth discussion. Though a difference in climate may account for part of the difference in value, there are methods in the cultivation of the nut and the preparation of copra which, if attended to in Ceylon, should increase the production of nuts and improve their quality and, therefore, the value of the oil. The climate of the West Coast of India differs greatly from that of Ceylon. The south-west monsoon beginning about the middle of May is generally one continuous downpour until about the first week in August; during which period mostly 100 inches of rain are measured, some 20 more inches falling during other parts of the year. In Ceylon

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* Prices in London (6th October) Ceylon oil £22, Cochin oil £29 10s to £30,

the average fall in the lowcountry ranges from 90 inches at Galle, 88 at Colombo, 68 at Negombo to 54 at Chilaw. The temperature in Cochin ranges from 80° to 90° Fahr.; whilst on the sea coast in Ceylon the thermometer averages only about 79 at Galle and Puttalam and 80 degrees at Colombo. In both particulars there is therefore a considerable excess over Ceylon.

"The cultivation of the coconut palm for nut-production and copra-making so far as these terms are applicable to Ceylon, is much influenced by the character of the natives of the two countries. The Sinhalese are not a painstaking people; the natives of South India are more intelligent and will take very much more trouble in all the work of their hands. No doubt the natives of both countries recognise the good old proverb, that 'the coconut tree likes to hear the people talk.' and the good effect of burning the dry fallen leaves underneath them to destroy injurious insects. The Indian 'prunes' his trees; that is, he cuts away the old stalks which have borne nuts. For cultivation a very simple process is practised, viz., breaking up the soil about the root generally into little heaps, into which are brought the ashes of burnt leaves, at the time when the immediate advent of the monsoon is apprehended. Both these simple processes increase the yield of nuts, so that in ordinary years there is a bunch of ripe fruit, often of 12 nuts, to be gathered every month.

"The making of copra is a careful operation in India; and far otherwise in Ceylon. The nuts when opened are not placed on the bare ground in the sun or exposed to a fire, but clean mats are put down to which the women attend, taking them in at night or covering them over on the approach of rain. The pressing of the oil by the checku is the same in both countries*; but even in this part of the process the Indian is the superior in cleanly methods.

"These few hints are given for what they are worth. It is not supposed our native friends in Ceylon will change their methods; but European proprietors and superintendents of coconut plantations by accepting these recommendations may increase the produce of their trees and improve the quality and value of their oil. Sometimes a red tint is observable in the oil. This arises from too long delay between the gathering from the tree and the conversion of the kernel into copra by exposure to the sun; especially when the nuts in their husks are piled in heaps in the open air, germination having commenced within the shell. These should be carefully avoided, germinating nuts being discarded. What is desired is a clear colourless oil when finally pumped into the casks for shipment, to procure a white solid sample when offered for sale in London or at the Continental Ports."

We now return to the practical question with which we opened. Surely, we may say we have as good coconut palms in Ceylon as on the Cochin coast; as good soil and a climate equally favourable at least in the districts North of Colombo (and in Batticaloa and Jaffna?); and if this be granted what is to hinder equally good copra being prepared here? It seems to us that the explanation must be found in the greater care exercised by the natives of Cochin in their handling and drying of the copra—a fact that is testified to by both our mercantile correspondents, and that it should be quite possible, say in the Marawila and Chilaw districts, if not in the Negombo district—to prepare with a little extra care, copra equal to that of Cochin.

For instance, not only can Negombo, Marawila and Chilaw (including Rajakadaluwa) boast of most luxuriant palms growing in fine soil; but even Cochin can scarcely show a much larger number of dry sunny days during which copra might be prepared. We find that the meteorological

* We suppose there are European oil-preparing mills at Cochin as at Colombo: COMPILER.

record for the several centres of coconut cultivation in Ceylon runs as follows:—

Name of Station.	Average annual total. Rainfall:	Rainy days:	Dry days:	Side of Ceylon
Colombo	88·52	171	194	West
Henaratgoda	93·84	148	217	West-inland
Kalutara	86·03	151	214	South-West
Galle	91·47	206	159	South
Matara	68·26	99	266	South
Negombo	67·14	98	267	West
Chilaw (Horakelle)	65·45	92	273	North-West
,, (Rajakadalua)	54·50	106	259	North-West
Puttalam	46·36	78	287	North-West
Kalawewa	50·14	76	289	North-Central
Kurunegala	84·12	168	197	Central (low-country)
Jaffna	47·68	72	293	North
Batticaloa	54·85	101	264	East

From the above we would specially select the Negombo, Chilaw, Kurunegala, Jaffna and Batticaloa districts and ask, for what reason—if sufficient manual care be taken—as good and attractive copra cannot be prepared from the coconuts in each of these as in Cochin? We have heard, indeed, of plantation copra from Batticaloa being pronounced very superior to ordinary Ceylon. Is this an established fact? If there is no other remedy, would it not pay on some of our plantations to import some natives of Cochin accustomed to manipulate the coconut kernels for copra in that State?

We await the opinions or experiments of practical planters in the districts referred to, from whom we shall be glad to hear on the subject; for surely, if increased care in preparation increase the price of a great part of Ceylon oil even ten or twenty, much more by thirty-six, per cent., there is ample reward awaiting the experiment. One point may be raised as to the greater proportion of stearine in Cochin coconut oil; if this be due to soil, we should have to get samples from Cochin to analyse and compare with our Ceylon coconut soils*; but we cannot believe there can be much difference in this respect between the best of our West Coast and the Coast of Cochin. The difference is most likely to arise from the more careful manipulation, as already described, of the kernels to secure the best copra. All this should be within the reach of coconut estate proprietors in Ceylon at least in some of the districts we have selected as most allied to Cochin in climate and soil.

CEYLON *Vs.* COCHIN COPRA.

On the subject of the above article we have drawn up the following questions and circulated them among authorities in Colombo who have not already given us their opinions:—

QUESTIONS:

The following are the questions embodied in our Circular:—

1. Have you ever considered the reasons for Cochin oil selling for 30 to 36 per cent more than Ceylon Coconut Oil?

2. What is your opinion after having read the article in *Ceylon Observer*, of 30th October?

3. Do you think it possible in your District to give the same attention to palms and kernels as is given by the Cochinese according to the description under notice?

* There is a valuable chapter of analyses for "Coconuts" (soils, nuts, oil &c.) in Cochran's "Ceylon Manual of Chemical Analyses."—COMPILER.

4. Any objections or difficulties in your district.?
5. In what Districts of Ceylon would you think the best results could be obtained?
6. Would you recommend a Ceylon Superintendent being sent to Cochin to note what is done there from beginning to end; the nature of the soil, cultivation of palm, etc.?
7. Or, would you recommend getting two or three Cochin natives accustomed in copra and oil-making to lead on local plantations?
8. Do you know of any Ceylon estate or district whose copra or oil is always superior to ordinary Ceylon oil, and approximates to Cochin?
9. Any other observations?

The first set of answers to reach us, is from Messrs. Volkart Brothers, and this firm with prolonged experience both here and in India, shew clearly that much more might be done with Ceylon copra :—

ANSWERS TO CIRCULAR.

No. I.

1. Yes; Cochin copra is never smoked or kiln-dried, always sun-dried; hence the oil, that is pressed out of it, becomes whiter.
2. Our opinion is that if the same method in preparing and drying copra as at Cochin, were practised in Ceylon,—Ceylon oil would equal Cochin oil or nearly so.
3. Certainly.
4. ———.
5. Jaffna and Batticaloa.
6. For merchants and mill owners it makes but little difference, whether ordinary or white oil is being shipped. It would certainly be to the interest of planters, to adopt Cochin methods and send people over to study these or employ Cochinese here.
7. We are the largest shippers of copra from Ceylon and employ Malabar people to superintend drying, etc.
8. Calpentyn, Jaffna and Batticaloa supply the best copra: Madampe the worst.
9. ———.

Per Pro. VOLKART BROTHERS,
A. BOHLMANN.

The following have been received from well-known planting authorities:—

No. II.

One reason for Cochin oil fetching more than Ceylon oil is, that the process of manufacturing it is quite different in the former place from that of the latter. Cochin nuts are smaller than Ceylon nuts and the outturn of oil is roughly speaking about $2\frac{1}{2}$ cwt. per candy for Cochin against 3 cwt. for Ceylon. The coconut area in Cochin is small as compared with Ceylon, and more care is taken there in the plucking and the drying of the nuts. Only ripe nuts are plucked and the kernel is cut into slices, and carefully dried in the sun. All unripe and bad nuts are removed and only the good clean white copra is manufactured into oil. This is the white oil of Cochin and it is used in some part of India as a substitute for ghee. Monsoon-made oil sometimes fetches the same price as white oil, if the quality is fine, but the objection to monsoon-made oil is, that it is, as a rule, off the color in consequence of the damp weather rendering the copra liable to get mouldy, but of course there may be some fine oil made during the monsoon. Greater care in the plucking and drying of the nuts may be bestowed in Ceylon, but the area is too wide, and the climate will not permit of the proper drying of the nuts in the sun. Nuts are plucked anyhow or nohow here, split into two and thrown to dry in the sun, and if the weather is bad, all the kernels are put on a platform and smoked, which blackens the copra and imparts to it a smoky taste. The copra is then hurried off to the

carts or boats to Colombo. Little or no trouble is taken to separate the good copra from the bad nor the white from the black. All come to the mills and it is this produces the Ceylon oil.

White oil, indeed, is manufactured in Colombo but the demand is limited and manufacturers do not keep a stock of it. It fetches about R20 per ton over ordinary good merchantable oil. A good deal of care is taken on some of the estates owned by a well-known Ceylon gentleman, and the copra from these properties always fetches quite R1 per candy over ordinary quality. The best result would be obtained in the Chilaw District. Copra is frequently brought into Colombo from Batticaloa. The climate being dry there the shells get hard soon. It is for this reason that the nut is broken the other way, from top to bottom, for, if the usual custom was followed, the shell would get "splintered" and damage the kernel,

There is but little use, in my opinion, of either sending a Ceylon Superintendent to Cochin to learn the method of manufacturing or in bringing over Cochinese to teach the way how to do the work in Ceylcn, so long as our climate is what it is. The Cochin men may lead in anything, but they cannot control the clerk of the weather; we have rain almost throughout the year and the coconuts cannot be kept on the trees.* They must be plucked, and rain or no rain, the copra is made and quickly converted into cash! Some years ago a firm of mill-owners manufactured oil from selected copra brought from their own estates. This was superior to ordinary oil and always commanded in London about £1 per ton over the value of ordinary Ceylon, but this firm have now gone largely into the Desiccating line and have given up oilmaking. In this connection it must not be forgotten that copra from the Pacific South Sea Islands, Australia and other places, is imported into Liverpool and this competes to a large extent with our oil. In the "sixties" and "seventies" during the existence of Armitage Brothers and C. Shand & Co., a very large business was done in Ceylon coconut oil, the contract being sometimes for thousands of tons at a time. The former firm who owned Mills at Mattacoolly and Mutwal were very large charterers of sailing vessels, and some of the largest ships that ever loaded here were chartered by them. The volume of business then was done direct with London, but now everything is changed and the news telegraphed out that the stock of coconut oil was 200 tons, the month's landings 200 tons, and the deliveries 200 tons, points to what straits the business in coconut oil with London has come to in 1897 compared with what it was in 1860-70. C.

No. III.

1. Yes; and if you will look up the *Tropical Agriculturist* for 1895 or 1896 you will find that this question was discussed in the *Ceylon Observer* and opinions elicited.

2. My opinion is that the great difference is almost, if not entirely due to the large amount of stearine in the Cochin oil.

3. Quite. Although there is not the same long spell of dry weather; yet copra dried over coconut *shell* fires can be cured quite as white as sun dried.

4. None except the more frequent rains preventing copra being sun dried.

5. In Jaffna, Kalpitiya, Batticaloa, and Chilaw. I am quite sure that copra as fine as any Cochin article can be, and is prepared, in these districts.

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* Our correspondent forgets our dry districts—some with 250 to nearly 293 dry days!—COMPILER.

6. Perhaps it would be advisable. There *may* be something done there of which we are ignorant, though I doubt it !

7. No; by no means.

8. Answered in No. 5.

9. I am afraid that the difference is due to climate and soil and perhaps, to some extent, to keeping the nuts for so many months before converting them into copra. Is there no reliable person in Cochin from whom information might be got? W. J.

No. IV.

Oct. 5, 1897.

1. The difference in price of Cochin and Ceylon coconut oil attracted my attention many years ago. The experts in the trade whom I consulted, referred the difference, partly to Cochin oil being richer in stearine, partly to speculation and combination among owners.

2. My opinion, confirmed by the *Ceylon Observer* article of 30th October, is that a third explanation is to be found in the fact that most of our copra is smoke dried, much of it positively black, yielding oil which cannot be filtered white.

3. Not the same, perhaps, to kernel, because greater humidity of the air and greater rainfall; but more attention than now. To palms the same attention can be paid as in the most favoured countries.

4. The special difficulty in the way of sun drying in this district is the absence of the sun for a good part of the year. Half the number of days in the year is wet or drizzly, and the sun is often obscured by clouds; but smoke drying is resorted to too readily.

5. In Jaffna, Batticaloa, Mannar, Kalpitiya, and Puttalam. If the copra from these districts should sell distinctly better, not only because it is better dried through its long journey but because it is sun-dried, other districts would resort to open air-drying whenever possible.

6. It would be an advantage, but it is not absolutely necessary. Cultivation is understood here and is being practised with good results—larger crops and thicker kernels.

7. That, too, may be desirable, but is not essential. Copra drying is a simple process and every one knows that well dried copra is more valuable than damp, and clean is preferred to dirty. There should be an incentive to greater resort to the sun than to fire.

8. The copra of Jaffna, Batticaloa, Puttalam and Kalpitiya is generally superior to that of other districts because it is cleaner and better dried and it fetches better prices, because it contains less moisture. The oil of one district cannot be compared with that of another, as there are no district mills and district oils.

9. For the above reasons I do not agree that is merely a planters' question. If the mill-owner offers more for sun-dried copra than for smoke-dried, in order to prepare white oil as a speciality, there will be inducement for planters to avoid smoke or steam drying, except as a last resort. F. B.

No. V.

Nov. 4, 1897.

I have not had any practical experience in coconut oil manufacture—so cannot reply to questions 1—7. As regards (8) I can only repeat what I heard from Mr. O'Grady of Karativoe estate, who told me he took home some of his (chekku-mill oil) and submitted it to some large dealers in London, who, after examination, assured him that it was far superior to

ordinary Ceylon oil, and I think he said equal to Cochin; but that to secure a proper price it should come into the London market under some different designation than "Ceylon" oil.

On another occasion I know Mr O'Grady made some very superior Copra for a local Chetty, who sent it to Calcutta (to be used he said for sweetmeats), but it took a lot of trouble and additional expense and did not pay.

So these facts show it is in the long dry season which prevails on the Eastern side of the island that there could be prepared a superior class of copra and oil.

Mr. O'Grady would give fuller particulars doubtless if asked.

I may also mention that in the Batticaloa estates, the nuts are left (I think for a month) in the (coir) husk before being split—which is done with an axe without removing the husk.

E. ELLIOTT.

No. VI.

1. For the reason that no endeavour is made in Ceylon to export white oil. I saw a sample of white oil in Colombo some time ago, which, if exported, should approximate, if not equal, Cochin oil.

2. Except as regards any superiority due to climatic conditions, there is no reason why Ceylon oil should not be as good as Cochin.

3. The attention given to palms on my estate is quite equal to that in the description you notice. In the treatment of kernels too, I do not see any difference between our methods and those adopted in Cochin except as regards the use of mats.

4. I believe there is not so much uniform sunshine here as in Cochin, hence we are obliged to have more recourse to fire. In drying by fire there is now no means of excluding the smoke, which accounts for the bad colour. If the smoke could be excluded by the introduction of some kind of Sirocco, I think much of our difficulties may be overcome.

5. Kalpitiya, Puttalam, Rajakadaluwa and Chilaw should do well. I believe Jaffna and Batticaloa would also do, although I have no acquaintance with them.

6. & 7. I do not see any necessity of adopting either of the suggestions. Given good weather and good nuts there is no difficulty in making white copra.

8. No.

9. My experience is that nuts of estates on the sea-board make the best copra. I think this superiority is due to the presence of salt in the soil. If some means could be devised for obtaining salt at cheaper rates for manuring purposes and better methods of manuring are adopted, I think our nuts will not be much inferior to those in Cochin, and if some method can be devised of drying copra by means of a uniform heat without smoke, I think we will be able to manufacture a very superior oil in Ceylon.

D. J.

We direct attention to two thoroughly practical communications discussing this matter below. One is from the Manager of a large plantation in the Rajakadaluwa district beyond Chilaw, which ought to be specially favourable for sun-drying and the other bears the initials of an old contributor who will be recognised as almost "the Patriarch" among coconut planters, at any rate in the Western Province of Ceylon. The former supplies a great deal of out-of-the-way information as to the careless, if not fraudulent, way in which copra is treated by native owners and middlemen before reaching the mills; and both writers seem to make it evident

that the Mill Managers are pretty well helpless in refererce to reform—since they must take the copra as offered, and it would not be profitable for them to deal seperately with small quantities of cleanly superior or sun-dried copra.

But "W.B.L." shows us very plainly how private estate owners in Ceylon, anxious to do as much justice to their nut-kernels as is done in Cochin, can accomplish their purpose. We infer from what he says that a "Sirocco" (or query "Dessiccator")—or even a more primitive contrivance described by our correspondent, would enable copra to be properly dried even in our wetter districts; while in the dried series—which must have as many sunny days as Cochin—the result can be arrived at with a little care more simply and economically. "W.B.L." tells us of a proprietor of 200 acres of coco-palms who regularly prepared his own copra and manufactured superior oil from it on the estate, we suppose at a considerable profit over his neighbours' return? With this example before them we do not see why a good many individual planters should not go and do likewise and secure in the London market not £21 to £22 but £29 to £30 for their oil. "W.B.L." says it should pay to erect a Mill (with hydraulic presses) for 50 acres; but to make the venture safer a Syndicate of proprietors owning not less than 1,000 acres—or why not a Limited Company buying up estates to that extent?—should be tried to establish a Mill to manufacture only superior Ceylon oil. No doubt, a distinctive mark would have to be adopted to secure due attention in the London market. With a margin of from 30 to 36 per cent. to go on, it does not seem to us that encouragement is wanting to deal with an enterprise of this kind.

No. VII.—(*Answer to Circular by a Rajakadaluwa Manager.*)

Nov. 6, 1897.

I have read the leader of *Ceylon Observer* of the 30th ultimo with great interest. The superiority of the Cochin coconut oil, as evidenced by the high price it obtains in the London market, is a matter well worthy of our consideration and the remarks made in the leader are quite to the point. The opinions expressed on the subject by the authorities quoted are perfectly correct so that little remains to be added. Considering what large tracts of land in Ceylon are under coconut cultivation and what vast quantities of copra are prepared, it behoves us to put our best foot forward and see if we cannot successfully compete with our rival, but what is the use of the energy and care of a few when the vast majority of the natives in this island engaged in the coconut industry are notorious for their apathy.

To make good copra, as made in Cochin, three things are of paramount importance:—*1st, the choice nuts*; *2nd, mode of manipulation*; *3rd, time of drying.*

1. With regard to the choice of nuts—these should be thoroughly well matured and dry *on the tree* before plucking and of a dark brown colour. Nuts that are so dry that they sever their connection with the parent tree by their own weight and fall on themselves, are the best adapted for making copra. The Cochin nuts are so gathered and I suspect this accounts for the larger percentage of stearine in the Cochin oil. By this method two bunches of thoroughly matured nuts may be relied upon from a well-bearing tree and the third or less matured bunch may be left to form the first bunch of the next crop and so on. These nuts should be plucked once in three months instead of two months so as to ensure two perfectly dried branches. The nuts when plucked should not be left in a heap longer than three weeks or a month by which time the kernel is so far desiccated that it comes away from the shell after a slight exposure to the sun and very often the moment the nut is split. Germinated nuts should be avoided if a first-class copra is to be turned out. The general rule of Ceylon is to pluck once every two

months. I think this accounts for the inferiority of our copra, for immature nuts are bound to be mixed with the mature ones even on the best regulated plantations.

2. As regards the manipulation, nuts should be placed in a fierce sun as soon as they are split, care being taken that no sand or earthy matter adheres to inner surface. Where practicable they should be placed on mats and cadjans till the surface moisture sufficiently evaporates, leaving a dry inner surface to which foreign substances cannot cling. This can be ascertained by passing one's fingers over the inner surface a few hours after the nuts are exposed. When this amount of dryage is ascertained and the kernels are detached from the shells, mats and cadjans are on longer needed, and the kernels may then be placed on the bare sand (the looser and whiter the sand the better) till thoroughly dried, without any fear of taint. Where large quantities of copra are prepared at a time it is not always feasible to effect the preliminary drying on mats and cadjans, but it is trouble well laid out when the ulterior benefit is taken into account.

In Ceylon the natives are very careless as to what becomes of the nuts in the splitting. They are split and chucked about anyhow, rolling over muddy ground or dirty sandy soil clogged and damp with coconut water or over patches of cattle dung or any dirt that is lying unswept. The nuts are then spread out to dry with a large percentage of earth sticking to them, thus rudely spoiling their snow-white appearance. The earth matter leaves its stain and quantities of sand are embedded in the body of the kernel. This is regarded by the natives as the proper thing to happen as it increases the weight of the copra, I have seen sand actually thrown on the newly-split nuts for this very purpose. How is it possible to obtain a good merchantable copra when men are capable of such nefarious practices? In some instances the coconut water is not all out of the split kernels when exposed to the sun, a small portion at the bottom is allowed to remain and evaporate slowly (as it is too much trouble to throw it out) and in this slow process of evaporation a sticky gummy substance is formed which clings to the bottom of the kernel and readily holds any rubbish that may eventually come into contact with it.

The kernels should be placed closely side by side to dry, but no nuts should be split after 11 a.m., as those split in the morning get the benefit of a full day's sun, whereas those split in the afternoon may, or may not, get a dry inner surface by the evening. This is an important factor in the drying process, for damp on the inner surface all night long is apt to engender a sticky substance which may induce mildew before the sun rises next day and present a sorry appearance in juxtaposition with the better dried kernels.

The kernels should be placed in long narrow heaps about 8 inches deep and covered with cadjans before nightfall so as to prevent the dew getting on them, as any watery interference with the oleaginous surface is most detrimental to the uniform colour of the copra. These heaps should next day be spread out again in the sun, as at first, and so on till perfectly dry.

Kernels dried on sandy soil dry quicker than those on ordinary hard ground, as the heat of the sand at the bottom is intenser than that of common earth, and helps to dry the kernel faster. A white colour is produced by hard bleaching.

When the kernels are well dried (which can be ascertained by a sharp snapping sound they make when doubled and pressed in the fist and by an even leaden hue perceptible in the broken portion where the escaping oil stains the outer surface) they should not be allowed to sweat too long in heaps. The sooner they are despatched to the mill the better for the oil they are expected to yield. Mildew forms thickly and rapidly and is most prejudicial to the making of a colourless oil; but with a nice, even, snow-white inner surface and a thoroughly sun-dried kernel, I don't see why the

good colourless oil should not be made in Ceylon equal to that of Cochin. provided no other copra of inferior quality is mixed with the good lot crushed. The heterogeneous mixing of all kinds of copra in the mills is a great evil. If good, bad and indifferent are all crushed together it is impossible to get any other than the amber-coloured oil now in vogue, which, when congealed, gives a palish yellow hue instead of alabaster white. The excess of stearine in Cochin oil, when makes it preferable for candle-making purposes, is, I suspect, due to the excellence of the nut and not to the superiority of soil—an excellence attained by full maturity and a regular system of manuring the trees—for the soil of the west and north-west coast of Ceylon compares favourably with any soil in the world as a feeding ground for the coconut palm.

3. As regards the time when copra should be made I am convinced that the hottest and driest season of the year before the advent of the south-west monsoon (*i.e.* between January and June) is the best. because it is the most reliable for heat and rainless days. Copra, to be white, should have no interruption in the process of dryage, save that of the night. It should run no risk—no heat but sun-heat being used. If it has to be transferred from the drying ground to be finished off over the "Atuwa" fire in the event of clouds or rain intervening, then good-bye to the hope of making a pure white copra. The smoke of the coconut shell-fire soon leaves its tell-tale mark on the inner surface and a browned, if not partially blackened, copra is the result. If the heat brought to bear on the kernels is not uniform and continuous, a brownish tint is observable on the borders and this tint is bound to tarnish the oil expressed therefrom. Should rain-drops find their way to the copra whilst drying, a spotted and motley appearance ensues and these spots of many colours, in the development of mildew, can never be removed, no matter how severely they may be subsequently dried. Undoubtedly the colour of the oil is affected by these accidents. Rain and dew are the the enemies of copra and should be carefully guarded against.

In Ceylon copra is made all the year round and plays at hide and seek with all weathers and consequently much damage accrues; but given a good season of the year, a well matured nut, thorough cleanliness of manipulation in a powerful sun, and careful handling in the mill, and it would be hard lines indeed if we could not compete with Cochin. Good white copra has been turned out from heating rooms, so well constructed as to be impervious to smoke and maintaining an equable temperature regulated by a thermometer. The heating room, if in good order, makes one independent of the weather, and if it involve no risk, should be resorted to by all proprietors of estates who turn their nuts into copra.

No. VIII.—(*Answer by an old Coconut Planter.*)

Nov. 8, 1897.

Few parts of the coconut districts of Ceylon enjoy sufficient sunshine at all seasons to dry copra without more or less damage. These unfavourable climatic conditions are not the only cause of injury to this product, as it is usual to sell the nuts on the spot, to middlemen, who make a trade of it, and probably, three-fourths of the crops of the Island pass through their hands. It is, of course, their business to make as much profit as possible on their tranasctions, and as a large proportion of the original weight is moisture, it is an object to get it to market, with the greater part of the moisture retained. It is therefore put into a rude kiln after a few hours in the sun, not to dry, but to be smoked which prevents mould and rot from setting in at once. Thus most of the copra brought to market is discoloured with smoke, and contains at least 50 per cent of its original moisture. The large buyers therefore regulate the price according to the average quality, the only distinction being boat and cart copra. This seems rather a

curious method of arranging prices, but there is some reason in it; boat copra comes chiefly from the dry climate, to the north of the Mahoya, where the drying process is less liable to be interrupted by rain, and if only half dry, when put into the boat, the drying goes on during the voyage of ten days or a fortnight, and it is perfectly dry when it arrives in Colombo. On the other hand, the cart copra is collected from the country round Colombo, within a distance of say thirty miles, and consists of the smoked article of the traders, and the still more carelessly prepared produce of the villagers. I do not know whether any change has taken place since I was familiar with the working of the oil mills, but then all copra that came in, was thrown in one heap, and taken to the stores as it came to hand This produced a dark-coloured article which is still—I believe—the character of all Ceylon oil, and so it must continue so long as the bulk of the copra comes through the trader and the villager.

Perfectly ripe nuts, cleanly and thoroughly dried, consist of 66 per cent. oil, and of poonac 34 per cent. The chekku cannot extract more than 60 to 63 per cent. of oil, but the grinding stones and hydraulic press can do more with the same material; but with the common quality of the copra delivered at the mills the yield must be much less. Perfectly clean and dry copra yields an oil, that in a glass, beside another of spring water, the eye cannot distinguish a difference. Whether Cochin oil is intrinsically superior to the produce of Ceylon is a question for the chemist to decide: but there can be no doubt that clean colourless oil, would command a higher price in the markets of Europe and America than the smoke-stained article now supplied. There is not however the least hope, that the trader and the villager will spontaneously improve their methods, and the mill owners probably make more profit on the existing system than they would do by a superior article.

The only hope of raising the quality of Ceylon oil lies with the Europeans who are going in for coconut cultivation, which they may do, by rendering themselves independent of the nut dealer and the mill-owner. It has been done before, and can be done again on the same or improved lines. A coconut estate planted in 1840 about 200 acres, owned by a non-resident European, manufactured all its copra on the spot, for twenty years with very satisfactory results. This was done by chekkus; but a property of 500 acres could afford to have its own mill, or several neighbouring properties might join in if convenient; at all events in a coconut district, nuts to keep the mill going could always be purchased at current rates. Every coconut estate should have an apparatus for artificial drying. Without that, no one can prevent copra, all the year round, from getting mouldy and spotted. A sirocco would do first rate; but there are cheaper means of attaining the end in view; anything will do that carries the heat without the smoke, say a sheet iron platform, with a fire of dry coconut husk, five feet lower, giving out heat without flame, and raising the temperature of the chamber above to 150 deg. which, if kept up for 48 hours, will thoroughly dry the copra, and so clean and bright, that the oil made from it will be perfectly colourless.

Once on a time, the Engineer of one of the Colombo oil mills showed me a phial of clean bright oil, which I duly admired, and asked by what process he had got it. He replied that was his secret. "Do you propose to take out a patient"? "I'll consider it" he said. "Well, I think you had best not go to that expense, for I could show you tons, as pure as that, and any one is free to inspect the process; it merely amounts to this:—clean copra makes clean oil'"

Ceylon may not be able to compete with Cochin in quality; but it is in her power to make the best of the material she has to deal with, and thereby gain both credit and profit.

W. B. L.

We append some half-a-dozen additional answers to our circular questions on this subject, so closing the discussion for the present. We trust some practical good will come out of it. We may say that the whole of the correspondence and remarks will be embodied in our forthcoming Coconut Planter's Manual. There can be little doubt, we think, that as regards both copra and oil from our drier districts—Jaffna, Batticaloa, Kalpitiya and Chilaw—only, as Mr. S. C. Munro hints, "a bad name"—a confounding of the superior with the general character of "Ceylon" copra and oil—can account for the value being placed lower than for Cochin. If that be the case, it rests with proprietors themselves, we think, to get matters put on a proper footing. Let them obtain standard samples of Cochin oil and copra from their Agents and then challenge comparison when they feel, in the drier districts, especially, that they have attained to the same standard. At the same time, experiments in the directions pointed out by "J. D. V." and other correspondents could not fail to yield interesting and perhaps, profitable, results. "W"'s idea of using a "Clerihew" for drying copra in the wet season is a very good one, and we hope to hear of success.

No. IX.

AN OFFER OF WHITE COPRA TO COLOMBO.

Nov. 7, 1897.

1. Yes. The reasons given in the issue of the *Ceylon Observer* of the 30th ultimo: are to the point. We of Pallai turn out much better copra than estates in the South, but nearly all our copra used to be shipped to Cochin! At present there are no purchasers here for the Indian market. In consequence price of copra has fallen, and we have to sell to the oilmongers.

2. I think it quite possible to make good clean copra rivalling that of Cochin, and indeed our copra is perfectly clean and white. I don't think there is much room for improvement over the Cochin treatment either of soil or kernel, though we don't use mats on which to spread the copra.

3. Matting would be excellent, but expensive. We heap the copra on the approach of rain and cover with *kudil* made of palmyrah olas and jungle sticks.

4. The only disadvantage is this: copra, if not sufficiently dry, is apt to get soiled and discoloured by heaping. Perhaps tarpaulin would be better to cover with, *without* heaping the copra.

5. Best results can only be obtained in the districts where the rainfall is lowest like Pallai: 40 in. average per annum. In the South where the copra is fired, it is sure to be discoloured, and the oil expressed from it to be anything but limpid.

6. I am not quite sure if a Ceylon man could profit much by going to Cochin. I think it had better be left to individual effort.

7. However I won't speak dogmatically on the subject. But I certainly should prefer the course suggested in (6) rather than get Cochin men over.

8. I think it is quite clear from what I have already stated that Pallai copra is just as good as the Cochin copra. The oil here is perfectly clear.

9. I was about to write to you when this paper came to hand *in re* quality of the nuts.

There cannot be any material difference between these and the nuts of the Western or Southern Provinces, or even those of the Cochin Coast—at least so far as they contribute towards the clearness of the oil. The so called "superiority" of the copra is simply the *whiteness* of the copra which is entirely due to careful preparation and fine weather. We have from 8 to 10 months of dry weather, which people in the South don't have. Hence our copra is white and better in every respect. We spread out the nuts

when split open on fine white hot sand, and the copra is hereby subjected to heat both on *top* and *underneath*. Thus the kernel comes out quite crisp and dry and perfectly white from the shell. It is only when we are disturbed by rain unexpectedly that the copra suffers and is apt to get discoloured and mouldy. It also gets soiled by being thrown about during heaping and then spreading out when the sun shines. The one problem that has been simmering in my head for the last 11 years since I settled here, is, how best to cover the copra *without* heaping it on the approach of rain. Tarpaulin might answer, but I have never tried it : and I am not sure if it is without disadvantages. My second question is what do *we* gain here in the North by our copra being whiter, seeing that we do not get a higher price for it than people in the South.

Supposing we take more than ordinary care with our copra and make it extra white and clean, what are the chances of getting higher prices, and what should be done to secure that end ? There being no demand for copra in Cochin, local merchants do not buy copra now. Our price is regulated entirely by the prices ruling in the Colombo market. It is as a rule R4 less per candy at Jaffna than the Colombo price, with its inferior copra. If, indeed, the Colombo Oil Manufacturers offer us sufficient inducement, I, for my part, can guarantee to supply good, clean, white copra, quite equal to the Cochin copra in all respects.

One disadvantage of spreading out the broken nuts on *mats* instead of on hot sand is that it does not get the benefit of the hot sand, and I venture to think that spreading on mats is not a very great advantage any way. I don't think the copra would be any cleaner by the precaution.

I dare say that in Kalpitiya and Puttalam they should be able to turn out just as good copra as here. Good well-matured nuts, (specially dropped nuts) *sun-dried*, without being exposed to rain, will make excellent copra. I don't think you have the climatic conditions necessary for the preparation of copra of superior quality, either in the Western or in the Southern Province.

JOHN F. PHILIPS.

No. X.

In answer to your circular on the above subject, the disparity between the prices for Ceylon and Cochin oil attracted my attention long ago, and I discussed the subject in the pages of a contemporary about a dozen years ago It was then said that the reason was in the Cochin oil being richer in stearine than Ceylon oil. Coconuts in Cochin were said to be stored on covered *messas* or platforms, under which small fires were lighted, till the nuts were quite dry and had absorbed all the water or milk in them. They were then converted into copra. Of course this method of dealing with coconuts can be practised only by small peasant proprietors and is not possible on large estates which have deal with hundreds of thousands of nuts at each picking, and when two crops are on the ground at the same time.

I think the proprietors of the large oil mills in Colombo will be able to inform you whether Cochin oil is richer in stearine than Ceylon, and how the white oil they turn out compares with Cochin as regards prices.

The communication of the retired Colombo merchant is very interesting and instructive. What he says about the application of ashes to the coconut tree only supports Mr. Cochran's recent analysis, that Potash is the leading mineral constituent of the coconut palm. Potash manures ought to be the principal manure for coconut trees, especially in sandy soils which are poor in potash, but not I think the only manure. It is gratifying to know that I am practising the style of cultivation which he says is practised successfully in Cochin *i.e.*, turning up the soil round the trees and leaving it in little clods. The advantages of thus aërating the soil are too apparent to need explanation. I always dig in manure round the trees, and do not apply it in circular trenches, and I leave the clods of earth as they

are. Further to prevent them from being battered down by the rain and caked by the sun, I use a mulch of coconut leaves and weeds. The loosened soil is then kept free and open for a considerable period. This is especially important in heavy soils which cake as hard as cement in dry weather. A friend, who followed my advice on a heavy soil, was full of the increased freeness and porosity of the soil which resulted from this treatment.

What your merchant friend says of the color of copra from germinated nuts is true. Desiccating mills will not use these as the stuff turned out is quite yellow. Copra likewise from these is quite discoloured and if dried over fibres turns out black. Of course it is not possible for large estates to dry nuts on mats, but barbacues are possible and should, I think, be made on every estate making copra. The disadvantages of keeping nuts to be cured till dry weather sets in, are that left out as they of necessity are in the open, the bottom layer of nuts go bad or germinate even when the nuts are well spread out.

2. There is the delay in realising their value. I think that with a little attention means could be devised to dry coconuts white over fires. That this has not been done yet is, I think, a reproach to all coconut planters. I know of experiments that have been made, but have been unsuccessful owing to sufficient thought not having been bestowed on them. Fire or smoke should not be allowed to come into contact with the nuts, especially in the earlier stages when they are not quite dry as they then get readily discolored. I think a simple plan would be to have sheet iron immediately under the platform of "waratchies" on which the nuts are placed.

Unfortunately everything on a coconut estate is done on the "cheap Jack" system. On coffee and tea estates expensive stores were and are built, and much money spent on up-to-date machinery. Not so on coconut estates. Everything is of the most primitive kind, and "cheap and nasty" is the rule.

3 and 4. Quite possible to give the same attention in this district and elsewhere to copra curing and cultivation as in Cochin, but since I came here we have had very little continuously dry weather. If after coconuts are split they have not two days *at least* of the dry weather the copra gets mildewed. But after this, fire drying does not discolor the stuff.

5. Puttalam, Kalpitiya, Jaffna, Batticaloa, and last Chilaw.

6 and 7. Hardly necessary. Copra curing is well-known here and we can dry white given the weather and failing the proper appliances. *i.e.*, a well-fitted hot room.

8. Kalpitiya copra always ranks first in the Colombo market and Marawila second. I do not know whether Jaffna and Batticaloa copra fills a large place in the Colombo market, but if it does there is no reason why it should not be classed with Kalpitiya.

9. Answered fully in the beginning of this paper.

I do not think it advisable for copra to be in direct contact with the fire-heated iron sheets. If a "messa" of "waratchies" will not live over the heated iron, won't perforated iron do? B.

No. XI.

1. Yes, but could not fathom it, as some years ago, (I believe even now) all copra from Jaffna was shipped to Cochin and the oil extracted there.

2. My opinion is, that it is not so much the copra that is to blame, but mode of extracting the oil.

3. Yes.

4. No. Considering it to be the driest district in the island more or less.

5. Jaffna and Batticaloa.

6. Certainly. A good idea.

7. Certainly, I should also recommend getting some Cochin natives.

8. No.

9. I do not think the tint observed in the oil has anything to do with delay in collecting and making into copra, and nuts should always be allowed to lie in husks for at least a fortnight or three weeks. T.

No. XII.

November 11th, 1897.

1. Yes and in my opinion
2. The vast difference between the price of Cochin oil and Ceylon is due principally to the better quality of copra the Cochin country is turning out.
3. I do not see why in dry districts the palm should not enjoy the same attention as it does in Cochin, and so with the kernels, if not all the year through, at least most part of it.
4. My district is one of the wettest and in such localities unless expensive factories are provided, with rooms heated by steam and free of smoke, the quality of the copra must be inferior to that of the dry district. It is unquestionable, though, that with care and cleanliness our present means should be sufficient to secure a quality of copra nearly as good as that now produced by our dry districts, and these in their turn go much nearer to Cochin. The colour of copra does not depend solely on the means of heat (sun or fire), but a great deal on the handling while curing. In wet districts it is in fact a matter of repeated handling and shifting from the drying ground to the drying tray, layer upon layer, and from this again to the ground. It is during this handling that the fibre dust of the shells, and other dirt sticking to the gummy kernel spoil the appearence of the copra. This could only be avoided by having a commodious hot room with plenty of trays where only one layer of kernels should be spread, but as long as our copra must be heaped up on a single drying tray eight to ten layers, one over the other, it will never turn out clean.
5. This is not the case in dry districts, where the split nut once spread out on a mat to dry, and simply covered at nights, can be left there until ready. Those districts certainly should be able to give better copra than what they give at present.

6 and 7. Systematical. clean sun drying, or improved accommodation for artificial drying, and well matured nuts are, in my opinion, all that is wanted; hence not much to learn in Cochin, or by a superintendent from a Cochin man here.

8. No, but I know of one estate in a wet district (with 128 inches up to 31st October) obtaining for its copra as good a price as Maravilla.

A NEW HAND.

No. XIII.

1. I have.
2. The principal cause is a bad name as regards the oil of this district, Batticaloa.
3. It is always done.
4. None.
5. Batticaloa, Jaffna and Kalpitiya.
6. I would not.
7. No.
8. Batticaloa, Jaffna.
9. In Buenos Ayres foreign wool growers can never obtain Australian prices from the bad name due only to the filthy condition of native wool.

S. C. MUNRO.

No. XIV.

1 and 2. Dr. Watt in his Dictionary of the Economic Products of India says that to produce fibre of the purest hue the green or unripe coconuts, *i.e.*, about ten months old, are used in South India,* and it may be that in this fact we have the explanation of the superiority of so-called "Cochin oil," with reference to which, too, Dr. Watt says that "he is almost forced to the opinion that by 'Cochin oil,' as with 'Cochin coir,' may be meant the superior qualities of the oil derived from the Madras Presidency." Several

* Nuts mature with us when about 12 months old.

gentlemen connected with the coconut industry of South India have told me that nuts are not allowed there to thoroughly mature before they are plucked, as the fibre of the immature nut is so much superior to that of the mature, and the oil, though less in quantity, is superior in quality. Another difference from Ceylon practice pointed out to me was, that the nuts are not allowed to wither as with us for two to four weeks (and sometimes even as many months waiting for better markets) before they are husked, but are husked within a day or two of their being plucked for the sake of the fibre from the green husk and presumably the kernels are dried at the same time as well. Ceylon experience in the preparation of cooking oil and hair oil also shows that a superior white oil is obtained from the immature or rather partly mature nut. Our cooks, too, prefer such nuts in the preparation of curries. A careful series of analyses of samples of best and monsoon Cochin and of Ceylon oils extracted from nuts at various degrees of maturity and withering is very desirable.

3 and 4. The Ceylon growers and dealers would be only too glad to pluck their nuts earlier and dry them sooner, if it be the fact that less maturing on the trees and withering in the heap, would pay them better. But as for more careful preparation of copra than in the practice now, I do not think that is likely.

5. In the drier districts, that is where the air is least humid, Jaffna, Kalpitiya, Puttalam, portions of the Kurunegala district and Batticaloa.

6. Yes. Will W. J. oblige? His long experience, open mind and clear judgment would be invaluable in such an investigation.

7. We have a large number of Cochinese working our chekku and at our oil mills, and I suppose they are also to be found in our large gardens.

8. Answered in 5.

7. I shall test on a few acres the value of "pruning" off the stalks that have borne fruit. Does the sap continue to nourish these stalks? If so, the advice to prune seems sound; but would the bleeding of the sap not attract the red beetle? J. D. V.-d-S.

No. XV.

1. Ceylon can produce as good oil as Cochin. The fault is that the men do not pick the nuts when mature. Natives as a rule send small quantities to the market, and the market people make copra from all sorts of nuts which are discoloured by their method of drying and smoking them. I am of opinion that we should dry our copra in a Clerihew's patent, similar to that used for coffee, and the husk and shell could be used as fuel. Mr. Levy of Levy Bros. & Co. told me that they kept the coconuts on a shelf above a fire-place for two months and this caused the oil to be clear and good. I have seen some oil extracted from desiccated coconuts which was as clear as water. I mean by and by to have a Clerihew's patent and to dry my copra by hot air.

2. We must dry our coconuts in the sun or by steam.

3. Certainly. I for one will do it.

4. No. Where there is a will there is a way.

5. If we dry our coconuts by hot air and carefully pluck. I believe all the districts in the island will produce good results In Jaffna, Batticaloa and these places the copra is better simply because it receives more attention than in the other places.

6. I do not believe there is anything to be learned.

7. No.

8. No.

9. I am fully convinced that if our coconuts are dried by sun the oil will be every bit as good as that of Cochin. W.

MANUFACTURE OF WHITE COCONUT OIL.

Colombo, Nov, 11, 1897.

DEAR SIR,—In connection with the discussion now going on in your paper it may interest you to hear that we have been manufacturing white coconut oil regularly for the last ten years.—Yours faithfully,

FREUDENBERG & Co.

[We are interested to learn that this description of oil has been regularly manufactured at the Hultsdorp Mills during the past decade. The question then is,—how does its value compare with "Cochin Oil," and whether it is sold in Europe under a mark which distinguishes it from Ceylon oil generally.—COMPILER.]

COCHIN *VS.* CEYLON COCONUT OIL.

OIL MILLS AT BATTICALOA.

BATTICALOA, 15th November, 1897.

Sir,—I have read the leader and correspondence in the *Observer* of the 10th inst.—Cochin *vs.* Ceylon oil—with great interest.

It might perhaps interest you to know that large quantities of our best sun-dried copra are bought up by middlemen and shipped by native vessels to Cochin, to be made into "Cochin" oil. This refers mostly to copra made by European planters, who take greater pains to produce good, clean copra, than the villager does. I know also that a considerable amount of copra is shipped from Jaffna to Cochin. The mill owners in Ceylon would turn out an oil, which would be quite as good as Cochin oil, if they would desist from making good clean copra with inferior stuff. On the estates I am in charge of every bit of discoloured copra is carefully picked out and sold separately. Mill-owners, however, don't seem to care to pay a higher price for superior copra, and therefore most estate proprietors don't trouble much above the making of good, clean copra. Mr. Le Mesurier, I am glad to say, is putting up an oil mill here, and I also hear, here that a similar establishment is likely to be started by another European. But I think there will be no room for two mills, as even a small mill will consume at least 50 cwt. of copra per day.

Yours faithfully, C. L.

JAFFNA, 16th November, 1897.

SIR,—You complained some time ago in your paper that the cause of the great difference in value of the Cochin coconut oil over the Ceylon article is due to the superior whiteness of the Cochin copra, which in its turn, is owing, to the fact that, at Cochin, the copra is dried more carefully than in Ceylon. It may interest some of your readers merchants in particular, that, in the Jaffna district, owing to the dryness of the climate, copra is dried by exposure to the sun, as soon as the nuts are plucked, and it is, I believe equal in quality to the best Cochin article. The oil made of it ought, therefore, to obtain as good a price.—Yours truly,

B. L. MARTYN.

SALT IN THE ASH OF COCONUT HUSK.

Kandy, Dec. 27, 1897.

Dear Sir,—Some time ago I sent you the results of an analysis of the ash of the husk of a coconut grown near the sea. The analysis shewed that the ashes contained a large proportion of chlorides, the total chlorine found being 24·80 per cent. equivalent to 40·87 per cent. of common salt. The inference from the analysis was that common salt should be regarded as an essential ingredient of plant food of the coconut tree; but to make certain that a large amount of chloride was normally present in the ash of coconut husk, and that this was not simply an accidental circumstance due to the proximity of the tree to the sea, it seemed to be necessary to prove by experiment that salt was also present in large proportion in the ash of husks of nuts of good quality grown far from the sea. A short time ago I had the opportunity of demonstrating this in the case of a well-grown coconut, much above the average size, received from Mr. Austin Fernando, of Veheralanda Watte, Kurunegala. I have not Mr. Fernando's letter beside me, otherwise I should quote from it, but it was stated in the letter that the nut was grown on land that had never been manured, and that the nut had been allowed to mature on the tree.

In the case of the sea-side nut, one-third part of the husk, cut longitudinally, was reduced to ashes. If the husk be regarded as built up of three carpels, then one-third part corresponds to a complete carpel

In the case of the inland nut, with a view to minimise the loss of chloride that is liable to take place during inconcration, as chlorides of the alkalies begin to volatilise at a red heat, I took only one-sixth part of the husk, corresponding to half a carpel. Assuming the two halves of a carpel or modified leaf cut longitudinally to have the same chemical composition, a half carpel may be regarded as representation of the whole husk, while a shorter time is required to reduce the smaller proportion of the husk to ashes, and the possible loss of chloride is therefore proportionally reduced.

The chlorine was the only constituent of the ash that I considered it necessary to determine. This amounted to 26·498 per cent of the ash, which is equivalent to 43·67 per cent of common salt. The following exhibits in tabular form, a comparison of the results obtained with the sea-side and with the inland coconut respectively.

	Seaside Coconut.	Inland Coconut.
Weight of coconut with husk	3·482 lb	4·407 lb
Weight of nut	1·693 lb	1·914 lb
Weight of husk	1·783 lb	2·494 lb
Proportion of husk used for analysis ...	one-third	one-sixth
Percentage of crude ash yielded by husk...	1·938	1·977
Percentage of chlorine in ash of husk ...	24·80	26·498
Percentage of common salt equivalent to chlorine in ash of husk	40·87	43·665
Weight of common salt equivalent to chlorine in one husk	01·417 lb	02·152 lb
Ditto in 1,000 husks same as those analysed	14·17 lb	21·52 lb

It will be observed that the larger coconut, although grown on an inland estate, yielded the larger proportion of chlorine; and even supposing the incineration of the husk of the inland-grown nut to have been conducted with somewhat less loss of chlorides, the legitimate inference from these two analyses is that a sufficient supply of common salt must exist on the soil or be supplied to the soil, for the successful cultivation of the coconut tree.

M. COCHRAN.

COCONUT PALM DISEASE.

Report of the Mycologist to the Imperial Commissioner of Agriculture on the disease of the Coconut Palm in Trinidad.

BARBADOS, 19th October, 1906.

During recent years considerable attention has been given in various parts of the Tropics, more especially in the West Indies, Ceylon and the Philippines, to the diseases and pests of the coconut palm. The great damage to the coconut plantations in Cuba through an epidemic bud-rot disease of the palms, which threatens to result in disaster to the whole industry there, the spread in late years of coconut root and leaf diseases in Trinidad and the continued extension of bud-rot in Jamaica, together with the recent "bleeding disease" noted in Ceylon, prove the necessity for more careful and systematic study of the various diseases the palm is subject to and the urgency with which curative measures should be taken up on the first signs of the presence in plantations of any of these plant diseases. The curious 'bleeding disease' of the coconut in Ceylon is under the careful investigation of the Government Mycologist, whose early reports will be duly published. In Trinidad the Mycologist of the West Indian Department of Agriculture, Mr. F. A. Stockdale, has made a lengthly investigation of the coconut diseases in Trinidad. We give here certain extracts from his interesting report made to the Imperial Commission of Agriculture, W.I.

THE INDUSTRY IN TRINIDAD.

The coconut thrives best on a thoroughly permeable soil, from which it can obtain a copious supply of water, and it is doubtless for this reason that the rich permeable, well-drained alluvial soils which generally border on the sea shore are held to be the best suited for successful cultivation. It would, however, appear that soil conditions are of far greater importance to the growth of the coconut than the exposure to sea breezes, for the amount of water present in the roots of the coconut palm show that a large supply of this fluid is necessary.

It is estimated that 14,000 acres were under coconut cultivation, in Trinidad in 1902, but the recent improvements in the prices for coconuts and their products has induced more planting to be done. A much larger acreage is now devoted to their cultivation. The chief coconut districts in Trinidad are the Cedros and Icacos districts which form the south-western portion of the island, the coast line between Manzanilla and Galeota points on the east coast where the plantations are continuous (referred to in this report as the Mayaro districts) and parts of the coast line between La Brea and Cedros points on the west coast known as the La Brea and Oropuche districts. There are besides a few isolated plantations on the north known as the Toco district, and a few around Port of-Spain at Cocorite and Laventille. Visits were made to all the districts except Toco where the conditions were reported as being similar to those in some parts of Mayaro.

It was observed that soil conditions in most cases were fairly favourable, although much more could be done in the matter of systematic drainage and careful cultivation. Reference, however, will be made to the different conditions, later. From the above, it will be seen that the coconut industry of Trinidad is one of great importance and therefore it is reasonable to expect that any disease or diseases of the coconut palms, that were likely of becoming widely distributed, should cause considerable anxiety, especially when it was reported that of 25,000 trees on one plantation in the Cedros district over 3,000 trees have been destroyed within the last twelve months and many more were showing signs of disease.

During the inquiry, three distinct diseases of coconuts were found, two of which are apparently due to the attacks of fungi, and one, until further information can be obtained, must be said to be of bacterial origin. One fungus attacks the roots and appears also in the petioles, and for convenience of identification the disea e caused by it will be referred to as the "Root disease." The other fungus attacks the leaves, and this disease will be described as the "leaf disease." The bacteria on the other hand give rise to rotting of the terminal bud and this will be spoken of as the "Bud-rot." Besides these diseases, insect attacks were noticed on three estates—a scale insect attack on the leaves on an estate in Mayaro district, a beetle attack on an estate in La Brea district and locusts on an estate at Icacos. My chief object at present is to submit a short and simple account of the diseases that have been investigated and to suggest remedial measures as far as possible.

It has been found necessary to introduce certain scientific terms in the body of this report, but the wording has been as simple as possible. In order that the destruction caused by fungi may be the more clearly understood, it should be pointed out that fungi can roughly be classed into three groups—(1) Forms which live only on living plants and animals (parasites); (2) Forms which live only on dead vegetable for animal matter (saprophytes) and (3) Forms which live on either dead matter or on living plants or animals (facultative parasites). Some of the fungi mentioned as attacking coconuts belonging to this latter class and whereas the living plant must be looked upon as a machine, (and any fungus, that is capable of attacking and killing its roots, must reduce the amount of water and food taken up by the plant from the soil, and any fungus, that kills leaf tissues, must upset the normal functions of the leaves), it is apparent that by continued action parasitic fungi on a healthy plant interfere with the normal physiology of the plant and ult mately cause its death, while the presence of large heaps of diseased material on a plantation may tend to further carry on its life. Disease is an extremely complex phenomenon, involving many reactions and interactions between the plant and its environment and, therefore, every disturbance of functional equilibrium has to be carefully considered before any definite conclusions can be arrived at. In this report every consideration has been given to the results of practical experiments and to the soil and climate conditions of the different localities in order that the *pros and cons* should be carefully weighed before any remedical measures are suggested.

ROOT DISEASE.

An attack of this disease is generally first shown by the leaves. They show a slightly wilted appearance, then turn yellow, first at the tips and then gradually all over the leaflets. These dry up, blacken, hang down from the "cabbage," and often remain for a considerable time before they are shed,—a badly attacked palm often being entirely enclosed in numbers of leaves around its trunk. Frequently, however, it is noticed that the leaves do not hang down around the trunk, but the petioles break across leaving the sheathing portion on the trunk, while the foliage portions of the leaves have fallen to the ground. Sometimes the petiole does not completely break and the foliage portion of the leaf hangs vertically downwards, attached to the portion of the petiole that is left attached to the stem.

The outer leaves are sometimes those that show signs of wilting and yellowing first, but this is not always so, for frequently palms may be noticed in which a "middle" ring of leaves becomes wilted and yellow, while rings of green leaves remain above and below. After the yellowing of the leaves, trees bearing a good crop of nuts, as a rule, gradually shed most if not all of them irrespective of their size and state of development, and the flowers subsequently produced do not set. In fact it is possible

for a person to pick out with certainty trees that are diseased before any yellowing of the leaves is noticed, by carefully looking at the condition of the leaves and at the latest flowers that are being put forward. Any trees that are diseased can at once be singled out. The local conditions of the soil must be considered before a tree is definitely stated to be diseased as the whole appearance of the diseased trees suggest a lack of water, and, therefore, may be confused with trees that are suffering from this cause alone in drought-affected areas.

An increased supply of water, either natural or artificial, will improve the conditions of drought-affected trees, but the wilted appearance of diseased trees, although it may be slightly less noticeable, is more permanent, and the symptoms do not disappear. After a number of the leaves have yellowed and died, it is only a question of time before the terminal bud falls over and becomes a putrid mass, and the palm eventually dies, as it has no power of branching or of producing a new growing point. [When a coconut palm is affected by any disease or pest, the terminal bud, in the advance stages, becomes involved in a rot. This must not be confused with "bud-rot" which appears to be a specific disease, as the roots, stem and leaves are sound, while the bud is in a diseased condition.] Trees which only present external signs of disease to the experienced observer show that apparently the roots are probably the parts which become first affected. After a considerable number of these have been rendered useless in contributing to the life of the plant, changes take place which result in a sour-smelling red discoloration in the stem that probably commences at the level of the ground and extends upwards. The position of this

RED DISCOLORATION

would appear to vary in the stem directly with the roots that are affected, and it has been repeatedly noticed that when a 'middle' ring of leaves shows signs of yellowing the discoloration is found towards the centre; while if the lowest leaves become wilted, the stem presents a ring of discoloration towards the outside of the stem. The petioles also show that they are infested with the mycelium of a fungus, for when the leaves become dry and hang down the fructifications push through the epidermis and form pustules of varying size and shape. Eventually, when the vitality of the tree has been reduced, the terminal bud, as already noticed, becomes infested with a 'rot' which causes the whole 'cabbage' to fall over, resulting in the death of the tree. Specimens of leaves, roots, stem, petioles, etc., were taken from a considerable number of diseased trees for examination, and for cultural and infection experiments. Although it has been impossible to establish with certainty the whole of the life history of the fungus in the short time that has been given to the study of this disease, yet some interesting points have been established.

LIFE HISTORY OF THE FUNGUS.

In working out the life history of the fungus it has frequently been noticed that the colourless spores become brownish in colour and afterwards become septate. Considering that no difference can be noted in the mycelia produced by the two fungi, that the wartlike pustules bear both kinds of spores, and that the colourless cells have been observed to be dividing by a single septum, I am of opinion that there is sufficient evidence to conclude that the septate, brown spores are the final results, (the colourless, unicellular cells being the forerunners) and that, therefore the fungus must be considered as a species of *Botryodiplodia*. The damage caused by the fungus in the roots by the disorganisation of the cortex cells has been observed and therefore the effect this has on the coconut plant may clearly be understood. The roots of a healthy plant conduct the water and food in solution from the soil to the leaves, and, therefore, when the fungus has destroyed a large number of roots a reduction in the water-absorbing power of the root system takes place. There are, however, few economic plants

that so quickly repair damage to roots as the Palmæ, and, therefore, the seat of the injury must extend through a large number of roots before it is of any consequence.

When a large number of roots are diseased, the water, etc., is absorbed in gradually decreasing quantities and, consequently, less food substances are elaborated. Young trees do not appear to suffer to any considerable extent for numerous instances have been noticed of young plants having quite a healthy appearance while a number of the roots were in a diseased condition. When however the fruiting period comes on, a large drain is made upon the tree. It is taxed very highly and, if the roots are diseased, wilting or yellowing of the leaves is noticed. It was observed that trees that were just coming into bearing were the most liable to succumb, although many old trees were in a diseased condition. When the root system, reduced in extent by the action of the fungus, is incapable of supplying the needs of the plant, the leaves commence to roll up, so as to reduce evaporation. Subsequently the leaves do not obtain sufficient water to keep their tissues alive and then they gradually begin to turn yellow and to dry up. The leaves are therefore unable to carry on their functions and the whole mechanism is thrown out of action. The general appearance of the plant is that of one suffering from "drought." The reason for attributing the damage of fungus in the roots are as follows:—

(1.) The external symptoms of the disease suggest lack of water.

(2.) The roots examined were in a diseased condition through the presence of a fungus.

(3.) Some instances were noticed in which the roots of dead or dying trees were diseased, while no fungal mycelium could be detected in the petioles.

(4.) As a rule several leaves begin to become wilted and yellow at the same time, whereas if the fungus in the petioles were the primary cause of the trouble, it would be expected that first one leaf and then another, and not a considerable number at once, would become attacked and die.

(5.) The red ring of discoloration in the stem which generally begins at the base of the tree first and then spreads upwards is closely associated with the death of the roots and the wilting of the leaves, but it is often noticed in the stem before the leaves turn yellow and before any fungus can be noted in the petioles. It would appear therefore that the discoloration in the stem should be attributed to the stoppage of water supply from below rather than disorganisation produced by cutting off of manufactured food supplies by the leaves.

THE GENERAL OPINION OF THE PLANTERS

of coconuts was that this disease is due to the weakness of the plants produced by the setting of immature nuts. In some districts histories of weather-beaten cargoes of green nuts driven on the shores and the nuts used for planting purposes, were held out as the cause of the trouble. This disease however is not limited to a few scattered trees, and evidence distinctly points to its being infectious. A tree that has become attacked by the disease is sooner or later surrounded by a large number of others showing signs of the disease. In one portion of the Cedros district, the disease has been noticed making its way gradually into other fields of coconuts further south. It is, therefore, impossible to believe that the large areas of coconuts in Cocorite, Laventille, Guapo, Cedros, and the interlands of Mayaro were planted with immature nuts. Moreover, the fungus found in the roots and in the petioles of diseased trees is capable of attacking vigorous trees; but anything that tended to reduce their

vitality would considerably help along the fungus. Circumstances which retard growth, both of the root and shoot system, give the root fungus a much better chance. This was conspicuously brought to my notice on a portion of an estate in the Cedros district. A low-lying hollow showed that a large quantity of water was present in the soil. Such a condition was unfavourable to good development of the trees: they were stunted in growth and showed that root development was not very large. The clayey impervious nature of the soil suggested that elaborate system of drainage was needed in order to procure the aëration necessary for vigorous plant growth. In this hollow, most of the trees had died out very rapidly and the disease had soon spread from this portion of the estate to other parts where the soil conditions were much more favourable. Trees on sandy soils on higher ridges were often noticed to be attacked, but it is generally in low-lying undrained hollows that the disease is the worst.

These examples should suffice to show how natural peculiarities of an estate and other physical features affect the disease, but these alone cannot be sufficient to cause the death of the trees, as is often urged. The characters of the soil affect the growth of the plant and they may also affect the fungus, and, therefore, it is necessary to keep the condition of the soil as good as possible, in order that it may be favourable to the growth of the plant. It is also commonly stated that

LACK OF CULTIVATION AND MANURING

is the cause of the trouble, and it should not be forgotten that every effort to improve the condition of the soil and render it better adapted to the healthy and vigorous growth of the root system may be a blow at the fungus, for some of the new roots would certainly go to replace those destroyed by the parasite. The presence of a parasitic fungus in the roots and in the petioles must, therefore, be held to be the cause of the disease and improvements in cultivation, drainage, manuring, etc., should be practised as they possibly may effect the disease indirectly by rendering the coconut plants more capable of withstanding its attacks. . . . .

In all districts the distribution of the disease seems to have been influenced greatly by unfavourable soil conditions produced by neglected cultivation. The interlands* of Mayaro show a fair amount of this disease, more especially in the low lying, poorly drained clayey soils. In all cases the disease was found to be the more prevalent on soils of a clayey nature, especially on those that were badly drained. It occurs also on sandy soils but seems to take a longer time to destroy the tree, and I am of opinion that it has spread on to sandy areas from the clayey hollows usually present in the coconut districts.

RAPID DEATH OF THE TREE.

In the Guapo and Cedros districts, where the disease is the worst, death of the trees appears to be very rapid. Three or four months is generally the time that intervenes between the first external symptoms to the death of the tree and usually within another three months a ring of diseased trees is noticed around the dead stump. In Mayaro the disease is much less prevalent and the death of diseased trees does not take place so rapidly, for in places where two trees are growing from the same hole, the death of the second usually takes place from 9 to 12 months after the death of the first. The distribution of this disease appears to be fairly general throughout the coconut districts, and considerable loss has been experienced in the southern end of the island.

* This term has been applied to the lands under coconut cultivation some distance inland from the sea, those that are not directly on the sea shore.

Numerous instances have been seen where diseased trees just coming into bearing have succumbed, and signs of old stumps surrounding them have been noticed. These examples would bear out the opinion of Mr. Hart that the disease has been present in the colony for a considerable time.

THE SPREAD OF THE DISEASE.

Samples of soil from around the roots of diseased trees have been investigated microscopically, and sterile mycelium, which appeared to agree with that found inside diseased roots, was present in them. This would suggest that the mycelium is capable of spreading through the soil. This mycelium may be capable of attacking and killing the youngest rootlets and then entering into the larger ones. The entry of the mycelium into the roots is still an unsolved problem, but evidence tends to show that the larger roots first show signs of infection where the smaller rootlets join them. In no case has the mycelium been noticed on the exterior of the roots and it would seem that it has to depend upon the rot of the smaller roots for its distribution. The roots of several young supplies, that were planted upon or near to the place where diseased trees have been removed, showed on examination, the presence of a mycelium within them but not in sufficient quantities to cause their death. This indicates that infection can take place through mycelium.

It would appear to be probable that the disease may spread :—

(1.) By mycelium through the soil from root to root.
(2.) By spores blown from tree to tree.
(3.) By germinating tubes of spores from petioles attacking either the roots of the same tree or the roots of another.
(4.) By germinating "chlamydospores" from decaying petioles.

The best conditions for the germination of the spores depend upon the presence of suitable quantities of air and moisture. and spread of the disease would be expected to be the most rapid when the conditions are the more favourable. The distribution of fungus spores by wind and rain will be dealt with more fully under the leaf disease and, therefore, will not be discussed here.

IMPORTANCE OF CULTIVATION.

The spread of mycelium in the soil depends a good deal upon the cultivation. Any condition of the soil that is unfavourable to the coconut may favour the root disease by hindering free root development. Excessive moisture and excessive drought may be favouring conditions for the disease. The latter cannot be remedied except by irrigation and does not appear to be a factor of any importance in this disease. The former-excessive moisture is noticeable in many of the low-lying portions of the estates. In these hollows, the soil is often of a clayey nature—impervious to water—and, therefore, many of the air spaces between the soil particles are replaced by water. The normal working and growth of the roots is interfered with and the destruction of such roots by fungul mycelium may speedily follow. The effects of excessive moisture can be lessened by careful attention to drainage and to the mechanical condition of the soil. The present system of cultivation of coconuts in Trinidad could be improved, and the attention of all growers of coconuts should be drawn to the progressive German colonists and to the Americans in the Philippines, where modern orchard methods are being successfully practised in the treatment of coconut estates, as improved cultivation would tend to retard the spread of disease. Although the complete life history of the fungus and its method of spread is not yet known with certainty it would appear that owing to its habit in penetrating and spreading in the living tissues of the root of the host plant, cure is practically outside the question when a large majority of the roots are permeated with mycelium, and therefore it is probable that only

the most drastic measures are likely to provide permanent relief. It cannot be expected that the disease can be entirely eradicated, but, by a method of what is known as 'stamping out,' the amount of disease may materially be reduced and the fungus kept in check.

METHODS OF FIGHTING THE DISEASE.

There are six principal ways in which we may hope to attack this disease. They are :—

(1.) Destruction of all diseased material.
(2.) Isolation of diseased areas.
(3.) Resting of infected land before 'planting supplies.'
(4.) Spraying an application of chemicals.
(5.) Improved cultivation and drainage.
(6.) Searching for and propagating disease-resistant varieties.

DESTRUCTION OF ALL DISEASED MATERIAL.—It has been observed that diseased petioles that have fallen to the ground often bear large numbers of spores. This would indicate that the fungus in the petioles is capable of living upon dead matter, *i.e.*, is saprophytic during some stages of its life-history. Young supplies, planted on the place whence dead trees have been removed have also been noticed to be affected and old stumps that have been left standing have become permeated with fungal mycelium. These instances show that there is sufficient food in the form of decaying vegetable matter in old trees, etc., to continue the life of the fungus and, therefore, all dead or diseased material in an infected area should be entirely destroyed and not left to accumulate.

(*a.*) All dead and dying trees should be cut down, and burnt whenever that is possible. When the trees contain a large amount of sap and still bear a fair number of green leaves it is almost impossible to burn, unless a number are collected and burnt in a pit after the manner of 'charcoal fires.' Otherwise these trees should be cut up and buried deeply with lime. The adoption of the burning method would probably prove to be the most effective, but experience will show whether it be the most practical.

(*b.*) All diseased leaves and petioles that have fallen to the ground should be collected and immediately burned on the spot.

(*c.*) On no account should rubbish, such as husks, etc., be allowed to accumulate in an infected area, for this may prove beneficial to the growth of the fungus, which may continue to live on it, and thus it would form a base from which the disease can spread to living trees.

(*d.*) The basal portion of the diseased trees and as many diseased roots as possible should be destroyed. It may be expensive to 'grub up' these stumps, but when it is borne in mind that the fungus can live in the old roots and is liable to attack young supplies, as well as probably to spread through the soil to healthy trees, such a destruction is necessary. An old East Indian coconut authority* holds that a large number of the roots of a coconut tree may be destroyed by cutting the tree near to the ground, leaving the stump for some time to dry, and then building a heap of trash and forming a fire (preferably closed by putting a thin layer of soil on the top) over the remains of the stump. In this way he states most of the roots will be destroyed, for once the fire has obtained a good hold it will travel for some distance down the roots.

There is also another

DANGER OF LEAVING OLD TREES AND RUBBISH

about the plantation for they offer sufficient food for beetles, etc., which may increase rapidly and become a source of danger. An instance of this

* All about the "Coconut Palm," Ferguson, Ceylon, p. lxxxiii. We have no experimental evidence of the value of this suggestion in practice, but it might be given a trial in the dry season when the weather conditions are favourable.

was noticed on a somewhat neglected estate in La Brea, where numbers of trees were infested with insect pests, that were doing considerable damage. It is necessary that all cultivators of coconuts should combine and have all diseased material destroyed for it is useless for any planter to keep his estate clear of all disease while his neighbour neglects trees, which become a permanent source of infection. Only the most energetic action is likely to prove beneficial, for it has been observed that there is a marked tendency for the disea e to spread from centres of infection. I am of opinion that it should be made compulsory for every cultivator of coconuts, no matter to however small an extent, to destroy by fire or otherwise all dead and dying trees on his grounds. The loss on some of the Cedros estates fully shows the destructive nature of the disease, and therefore drastic measure must be taken or otherwise the industry must suffer considerably.

Isolation of Diseased Areas.—The disease generally appears, at first, in small patches, while the surrounding trees are apparently unaffected. As the mycelium of the fungus may spread through the soil, these diseased areas may be isolated by cutting trenches from 1 foot to 18 inches deep around them. It must be remembered that the mycelium may have spread further than is noticeable on the trees and, therefore, the trench should be made to include several trees that are apparently healthy, and care should be taken to throw the excavated soil into the diseased portion and not outside it. Such a method of isolation, especially where the diseased areas are small, cannot be too highly commended in the dealing with root-diseases, but the amount of success depends entirely on the th roughness with which the work is carried out. In any case it may prove to be a very good method of confining the disease to a limited area.

Resting of Infected Land before Planting Supplies.—Young supplies that have been planted in infected land have shown that they have been attacked by the fungus and therefore it would appear necessary to rest such land for a series of years after removal of diseased material before commencing to replant. In this way it is hoped that the fungus mycelium may be starved out, and at the same time it affords an opportunity for careful cultivation of the land. Such land should be turned up, either with the plough or with the fork, so that the fungus mycelium may be turned up and exposed to the distructive action of the sun, and when supplies are put in they should not be planted in the old rows, but rather between them, so that the new plants alternate in chess-board fashion with the spots whence diseased trees have been taken. The careful cultivation of the land before replanting should improve the condition of the soil and possibly green dressings of some leguminous plant might be profitably grown and ploughed in. Some of the soils are already rich in organic matter and here some remunerative rotation crops might be grown on badly infected lands for a year or two before planting the young supplies.

Spraying and Application of Chemicals.—When diseased trees are cut down and destroyed there may be fungal mycelium left in the soil. As pointed out previously, a good deal of this can be destroyed by exposure to the action of the sun but it can also be destroyed to a large extent, by the use of lime. The lime should be, if possible, unslaked, as in this state its fungicidal powers are far greater than when it is slaked. It should be applied before forking or ploughing and the amount to be used must depend upon local conditions, and upon the extent of the disease. A method of preventing death of forest trees, etc., from root diseases in France is to lay bare the base of the trunk and as many roots as possible and to apply quantities of sulphur or Ferrous sulphate. An experiment was tried with the application of a 3 per cent. solution of a Carbolic Acid to the roots of several diseased trees at Cedros, but, so far, information respecting this treatment has not yet come to hand. The spraying of diseased trees with

Bordeaux mixture may also prove beneficial in destroying spores of the fungus and applications to surrounding trees might prevent them from becoming infected by spores blown by the wind.

Improved Cultivation and Drainage.—It has been noticed that the disease is the more destructive in undrained land. Stagnant water should not be allowed to remain in the soil, as this tends to hinder healthy root development and also favours the spread of the fungus. It would appear that water may be present at the roots of the coconut to almost any extent, but the necessary condition is that it should not be stationary. Proper drainage not only relieves the soil of excess of water, but also allows greater root development to take place, and thus secures the plant against effects of drought. The cultivation of land under coconuts is, as a rule neglected and instances have been noticed where old plantations have been giving smaller yields of nuts, that have been gradually diminishing in size, year after year. Better cultivation and drainage would offer more favourable opportunities for the coconut, and would probably be of considerable value in dealing with the root disease, especially in wet areas with soil of a clayey nature. It would afford a better chance for the plant to make use of plant food, either from the soil or from manures (the evidence of a planter in the Cedros district, which shows returns 120,000 nuts per year from an area that gave 40,000 nuts per year five years previously through judicious applications of manures, emphasizes the fact that the coconut readily responds, in some soils at least, to liberal applications of manures). It also would be expected that the condition of the trees would be considerably improved. By encouraging healthy growth and increasing the vigour of the trees, they will be able better to withstand the attack of the fungus.

Searching for and Propagating Disease-resistant Varieties.—A good deal of work has been done in combating plant diseases by selection of disease-resistant varieties, and therefore it may be a matter of the greatest importance to make further observations in this direction, as the selection of a resistant race of coconuts may prove of the utmost importance in combating these diseases. During my visits through the different parts of the island, I made careful observations and inquiries in this direction, but I am unable to say with confidence whether any varieties of coconuts are disease-resistant. Several planters state that a variety known as the "Green-Spanish" is very hardy and is able to withstand attacks much longer than other varieties. From personal observation in the badly diseased districts it would appear as if all varieties are attacked, but, if every coconut planter would note the comparative resistance of the various varieties, considerable advance in this direction might soon be made.

In conclusion it should be stated that in cases where the fungus has completely devastated large areas, the tree should not be allowed to stand and rot, for it would only be a nursery for the development and spread of the disease, and seeing that such varying conditions of soil and climate, etc., exist in the coconut districts it is not supposed that all the remedial measures suggested will be applicable to every plantation. Therefore it must be left to the planters themselves to choose those which they, from local experience, think to be the most applicable to their own particular conditions. The destruction of all diseased material on systematic lines however, should be practised by all, for it is expected that by such co-operation the injury would soon be mitigated to a large extent and the disease kept well in hand.

LEAF DISEASE.

Many trees are noticed which have leaves that appear to be drooping and with the tips of the distal leaflets of a greyish colour. An external examination of the leaflets shows that whereas the tip is quite dry and dead and that many parts of the edge of the leaflet are in a similar condition, there are small yellowish spots, more or less regular in shape,

which may be observed to increase in area, (spreading centrifugally from a point in a more or less circular manner), scattered about the leaflet. These areas may be observed to increase gradually in size and not infrequently to run into one another, forming irregular blotches, which often eventually cover the greater portion of the surface of the leaflet. During the growth of the spots, they graduallv change from a yellowish colour to a greyish white, and each is bordered by a margin which is of a dark colour, generally an intense greenish-brown. At first, therefore, it is easy to recognise the various "diseased spots" for in each the oldest part is always in the centre and as we proceed outwards from this, each successive ring has been more lately attacked than the last. This can be seen by the fact that the centres of the spots always become grey first while rings of yellow of varying degrees of intensity can be noticed outwards from this grey centre. By careful observation it will be noticed that the discoloration more often appears on the under side of the leaflet first, but the pale yellow, and later the greyish discoloured areas, are equally evident on both surfaces. This is due to

THE DISAPPEARANCE OF THE CHLOROPHYLL OR LEAF GREEN,

and the subsequent death of the cells comprising the tissue of the leaflet, as the diseased areas are generally sunken through being thinner than the healthy portions.

It would appear that the tips of the distal leaflets show the effects of the disease first, although an examination of an affected leaflet shows that diseased areas are scattered all over its surface, From these distal leaflets, the disease appears to spread gradually to those nearer the stem, and often when all the leaflets on the terminal 2-3 feet of the leaf have been attacked and appear in a dry, withered condition, this portion of the leaf breaks down, if the leaf happens to be floating in the air in a position between vertically upright and the horizontal. This end of the leaflet rarely falls to the ground, but remains hanging to the heathier portion, and is very characteristic of the disease. If, however, the leaf is older before it is attacked *i.e.*, hanging between the horizontal and the trunk of the tree, the tip does not often break. This shows that the breaking of the tips of the leaves is due to the weight of the diseased portion itself and is, therefore, due to natural causes. Many trees were examined that showed leaves with their tips broken off and hanging down in this manner and all showed that they had disease spots distributed throughout their leaflets.

The yellowish spots that are characteristic of the disease in such cases are found in the greatest abundance on the distal leaflets but eventually all the leaflets become attacked. After a time, when a large number of disease spots have made their appearance, the whole leaf assumes a yellowish appearance and gradually becomes greyish and withered. This may remain hanging to the trunk for a considerable time but finally it drops. In the early stages of the disease, only a single leaf may be attacked, but usually several are noticed on every diseased tree. As a result of the diseased condition of the leaves, the number of nuts borne on the later developed flower-stalks diminishes and finally no flowers set. When a large number of leaves have been badly attacked the terminal bud is left standing alone, and it is only question of time before this falls over, and the death of the palm results. Close examination on the upper surface of the leaf of one of the disease spots when it has assumed the grey colour, shows minute warts, not larger than the head of a small pin. They are blackish-grey in colour, and are irregularly distributed, often being very numerous. They are more or less oval in shape and suggest that the upper cuticle of the leaf has been raised. This can be shewn to be so, for if a diseased leaf that has fallen on the ground where sufficient moisture is present, be examined, it will be observed that these small pustules rupture, usually by a traingular

slit, through which a greyish powder protrudes. Specimens of leaves, roots, stem, etc., were taken from diseased trees for microscopic examination, and whereas the roots and stem appeared to be quite normal, the leaves were in a diseased condition. By cutting a traverse section through a diseased spot while still yellow, there could be noticed, by careful staining, a delicate, septate branched mycelium occupying the intercellular spaces and running between the cells. These eventually become pushed apart from one another by the invasion of this mycelium, from which minute branch-like structures are sent off into the cells themselves. They may possibly act as *haustoria* or sucking organs. Finally these branches appear to grow and eventually the cells and vessels of the leaf become invaded with mycelium, which probably causes the death of the invaded patches. The margin of the diseased spot is characterised by a ring of dark colour, and, examination shows that here the mycelium of the fungus is only intercellular and that the filaments end in this dark margin. This shows that the leaf is responding to the natural irritation caused by the invasion of the fungus and is probably secreting some substance with which to protect itself. Such an observation as this would suggest that the fungus mycelium is parasitic in nature and was capable of producing the death of the leaves. When the diseased spot becomes grey and dry, the minute warts on their upper surfaces begin to make their appearance. These small pustules bear the spores of the fungus.

A PARASITIC LEAF FUNGUS—*Pestalozzia.*

The infection experiments leave no doubt that this leaf fungus is parasitic and show that infection can take place by the germination of the spores the germinal tubes of which can pass through the stomata of the leaf and through wounds of any kind on the leaf surface. No result, however, was obtained when the spores were placed on the upper surface of an uninjured leaf, which therefore shows that these germinal tubes are incapable of penetrating through the epidermis of the leaf. Recently a report on a disease of coco-nuts caused by *Pestalozzia Palmarum*, Cke. by Dr. Charles Bernard has come to hand from Java. Differences occur in the description of the disease from Cuba (*West Indian Bulletin* Vol. vi. p. 313) and that from Java. In Cuba, the fruiting bodies of the fungus are described as being emitted from the under surfaces of the leaves, whereas in Java the fructifications occur on the upper surface only. The distribution of the disease in Java appears to be limited to young plants and seems to do the most damage when the young plants are beginning to take root in the ground, after they have exhausted most of the stored material from the endosperm of the seed. Despite certain differences in the appearance and size of the spores of the fungus found in Trinidad and that described from Java, the germination of the spores appears to be similar, and many symptoms of the disease in Trinidad are identical with those described in Java. I am of the opinion that the Trinidad and Java fungi are merely geographical varieties of *Pestalozzia Palmarum* Cke., and not distinct species.

Owing to the short time that was given the investigation of this disease, evidence could not be obtained on the time it takes from first infection by germination of a spore to the production of a yellow spot on the leaf nor on the time it takes for spores to be produced; but the following information on this point has been obtained during the work of Bernard on a similar disease in Java:—

'Two very vigorous coco-nuts situated near a diseased plantation were isolated and in the crown of one was placed a bunch of badly diseased leaves. After two months, (this is the periods of time that is generally considered to be the 'period of incubation' of the disease *i.e.* the time which intervenes between the moment that infection takes place and that when the first exterior manifestations of the disease appear) this tree

showed the characteristic spots upon its leaves, spots which grew and caused three months later (*i.e.* five months after infection) the death of the tree. The adjoining tree, which has not infected, remained healthy and vigorous.'

There can, therefore, be no doubt as to the cause of the disease or to the ease with which it can spread, for this parasite as seen by the above experiment, is the primary cause of the disease and is not a secondary appearance on plants in bad condition. It would appear, however, that the leaf after succumbing to the numerous drains upon its resources, falls to the ground before the mycelium has attained the possible limits of development; for if a leaf that has fallen in a dry place be placed into a moist chamber, multitudes of pustules bearing conidia will be produced within 48 hours, while, if a leaf that has fallen in a damp place, where it is shaded from the effects of the sun, be examined, large numbers of spores can be seen to be given off, thus showing that the mycelium is capable of further growth after the leaflet has fallen to the ground.

CAUSE OF THE LEAF DISEASE.

Evidence on the cause of the disease was gathered from planters of coco-nuts, but as in the root-diseases the general opinion was that it was due to the weakness of the plants, produced by setting immature nuts, or to impoverished soil conditions. It is impossible to believe that a large portion of an estate in the Mayaro district or isolated patches in the Icacos district would be planted by immature nuts alone, for the disease does not appear upon a single tree here and there. As to impoverished soil conditions, it is generally held that favourable conditions of soil are necessary for the growth of strong, vigorous, healthy plants, and therefore every effort should be made on the part of the planter to understand the different soil conditions of his estate and to assist nature whenever possible. This is the most perplexing question with which the planter has to contend, requiring judgment that can be gained only by many years of practical experience. From experiments previously mentioned there can be no doubt as to the fungoid nature of the disease and measures for combating its ravages will be considered later. The spread of the disease certainly appears to be influenced by the age and condition of the plants and therefore improved cultural methods are of paramount importance.

The primary damage done by this fungus has been seen to be the destruction of the cells of the internal tissues of the leaflets. This destruction continues if the conditions are favourable for the fungus and gradually the leaf-area of the plant is reduced. Under extremely favourable conditions, many of the leaves become entirely destroyed through the mycelium from a large number of disease-spots spreading throughout the whole of the interior of the leaf. When such happens, the whole of the leaf-area of the plant is destroyed, the terminal bud falls over, and the tree eventually dies. At other times large numbers of disease-spots are scattered about the leaves but not in sufficient quantities as to cause the death of the plant. These spots, however, have been rendered, through the destruction of the chlorophyll of the leaf, useless to the plant, and therefore, the plant becomes gradually weakened.

EFFECT ON THE NUT CROP.

To the planter, the most important of the checks is that given to flower development. Less flowers are produced and finally the diseased condition of the trees becomes marked in the shortness of the crop of nuts. Again food is cut off from the development of nuts, their size diminishes, and their saleable value becomes reduced. It has been noticed that in some instances the shortage of crop, etc., can be traced directly back to the damage done by the leaf-fungus. In some cases

where the 'disease-spots' are few in number little damage was noticed, nor do they seem to increase until the conditions become unfavourable to healthy growth of the host plant. It would appear, therefore, that this fungus is a weak parasite and is only capable of doing appreciable damage when the conditions are extremely favourable for its development.

The fungus that is present on coconuts in Java is also a weak parasite and there the damage seems to be limited to young plants just after being planted out, when they are sending out roots in search of food for themselves after having used up all the stored material of the endosperm of the seed. Therefore, if the conditions are such as to promote healthy, vigorous growth in the coconuts, the fungus may be overcome and its attacks, for a time at least, thrown off.

DISTRIBUTION OF THE FUNGUS.

The distribution of this fungus appears to be fairly general, for it has been noticed to a limited extent in Cocorite, Laventille, Guapo, Mayaro, (one estate) and Icacos districts, but it is probable that only in the last two is it doing any appreciable damage.—In Icacos three or four acres of diseased trees were noticed and the manager of the estate reported that their death was very rapid. As a rule, within four months after the tips of the leaves showed the yellowing, the terminal bud falls over and the tree dies. These areas were isolated from one another by considerable distances, although the first one was reported on the windward side of the estate. The district is considered to be a dry one, the soil being a good sandy loam, but it was ascertained that the diseased areas were limited to the driest portions of the estates where the soil was of poorer character than usual. In Mayaro the disease was distributed throughout the interlands of one estate, and many instances of trees dying out were noticed. This portion of the estate was low-lying, damp and poorly drained. The coconut trees were fairly good, and it was only in the badly water-logged situations that the trees were dying in any great numbers.

It has, therefore, been observed that although the fungus that causes this disease is commonly met with in many of the coconut districts in Trinidad, it limits its destructive ravages to such places

WHERE THE SOCIAL CONDITIONS ARE UNFAVOURABLE

to healthy plant growth. It has been shown, however, that this fungus can cause considerable damage and would certainly do so in a season unfavourable to the host plants and, therefore, it is necessary to consider what measures should be adopted to eradicate it from those portions of the estates where it is causing damage, and to prevent its further distribution.

REMEDIAL MEASURES.

A consideration of the life history of the fungus and the relation between it and the coconut suggest the remedial measures likely to be effective in dealing with the disease. The measures suggested can only aim at the reduction of the amount of the disease and at keeping the fungus well in check, for it would be impossible to suggest treatment that will entirely eradicate it. The remedial measures must be divided under two heads :—

(1.) Those which will destroy or weaken the fungus and,

(2.) Those which encourage a more vigorous growth of the coconut, so as to enable it to better withstand any attacks of the fungus.

(1) The spots of the fungus, under favourable conditions exist in such numbers that unless these are destroyed it is possible for the disease, given warm and moist, or windy weather, to spread very rapidly :

(a) All dead trees should therefore be cut down, all the portions carefully collected on the spot where the tree once stood, and the whole *burnt*.

Great care should be exercised in collecting the portions of diseased plants, and the burning should be done in the diseased area of the field, for if diseased leaves are carried or dragged about the field there is much danger of spreading the disease. Although it is only the leaves and petioles that are diseased, it would be wise to burn as much of the tree as possible in order to prevent decaying stumps being left about the plantation to become infected with other diseases and pests.

(*b.*) Trees that are showing a few diseased leaves should be climbed, the diseased leaves cut down and burned. The manager of the estate at Icacos has burned several trees that have shown signs of disease, by sending a boy up the tree, packing dry material in the lower leaf-sheath bases and setting fire to the whole. This method, in some instances, has given good results, for all the lowered diseased leaves have been bu ned and all the fungus spores destroyed. Considerable damage, however, is often done to the tree by this method and at least two or three crops of nuts are destroyed. It would probably be just as effective to cut down the diseased leaves and burn them on the ground for in this way damage by burning would not be done to the young parts at the terminal bud.

(*c.*) It would be advisable to search through the plantation to see whether any isolated trees show the characteristic broken-tips of the leaves with pustules on them, and if such are found these trees should be marked on the stem with a suitable mark so that they can be carefully watched, as they may possibly be the source of infection for other areas. All leaves showing signs of disease should be destroyed with fire and such should be examined at least once every fortnight until no further spread of the disease is observed. These trees should be carefully attended to, manure should be given them and the soil around them properly tilled, in order to enable them to throw off the attacks of the fungus.

Spraying with Fungicides.

(*d.*) If the disease continues to spread, spraying with fungicides would render the spores of the fungus incapable of germination, and would therefore be effective in keeping the disease in check. The fungus is the most easily assailed through those portions of it that come to the surface—the spores, for the germination can effectively be prevented by the use of chemicals; but the question remaining to be solved is how frequently it is necessary to apply such an external remedy. Without further information such a problem cannot be answered, but continued observation would soon reveal an answer to this important question. How soon after complete destruction of the spores will a fresh batch be produced on the same leaf? This is the question to be answered and such an answer must be a guide to the frequency of the use of fungicidal spraying.

Bordeaux Mixture would probably be the fungicide that would be used the most economically, and spraying with this would need a spray pump and a long hose attached to the pump. The nozzle may be tied to the end of a long bamboo, or a boy may be sent with it up the tree in order that the highest trees could be sprayed. All trees showing any signs of disease and any in their immediate neighbourhood should be sprayed at frequent intervals and thus most of the spores would be prevented from germinating. (Appendix 1 has been translated from *Bulletin du Department de l' Agriculture aux Indes Neerlandaises*) on the similar disease in Java and gives comparative results of different fungicidal agents, for in Java it is thought that spraying will prove to be the most effective method in preventing the spread of the fungus.

IMPORTANCE OF DRAINAGE.

(2.) It has been noticed that this disease, at present is doing serious damage only when the conditions of the soil and cultivation are unfavourable to healthy plant growth, and, therefore, in order to keep the coconut

palms in vigorous growth, such points as drainage, manuring and cultivation should be carefully attended to. In the interlands of the Mayaro district, which are low-lying and often waterlogged, the conditions could easily be improved by a system of drainage. The soil there is of a clayey nature and is somewhat impervious—not soil the most suitable to successful coconut cultivation. Some of the land is below the sea-level and, therefore it is impossible to obtain an outflow for the surplus water, but much of the surface water and that in the top six or nine inches of the soil might easily be removed by the digging of a system of wide drains about 18 inches deep. Even draining such a portion of the soil would prove beneficial to the coconut trees, as they feed mainly by roots in the top layers of the soil and therefore removal of an accumulated mass of 'sour' water should be an incentive to further root formation. Where the diseased areas appear to be on the light dry soils, the question of manuring and cultivation of the soil should be carefully attended to. Manures must not be looked upon as a means of curing disease, but they may be the means of strengthening the growth of the plant and the problem of manuring should be solved by the best resources at the command of the estates.

In having trees felled that were showing signs of the root-disease a tree was sometimes met which did not show the symptoms characteristic of the root trouble. The roots appeared to be healthy, the stem showed no signs of red discoloration, while the bud was involved in a vile smelling sort of bacterial rot. It was reported that about 1 per cent of the diseased trees in this district showed signs of a bud trouble, but that they were seldom met with except as isolated cases. On visiting a small savannah planted in coconuts in the Siparia district, it was noticed that the trees were in a diseased condition. The youngest leaves appear to stand upright and do not unfold as they should. Afterwards, they turn yellow and then brown in colour and the whole appearance is that of a withering tree with the centre of the cabbage in an unhealthy condition. Sometimes this dying of the "central bud" could not be noticed until many of the lower leaves had turned yellow or brown, nor did there appear to be any regular succession of deaths of the lower leaves, for often the lowest leaves were the first to turn yellow, while at other times the "middle" leaves showed the first signs of being unhealthy. After a time the terminal bud falls over, frequently leaving a ring of quite healthy-looking leaves at the top of a "headless" trunk.

On cutting down several of these trees it was noticed that while the roots and stem were perfectly healthy,

THE BASES OF THE YOUNGEST LEAVES AND THEIR WRAPPINGS

were in a rotten condition, as were also the bases of the still-unfolded flower stalks. This rot, in a diseased palm that is still standing, is invisible until the harder outer coverings of the bud are removed and it is found to be limited to the softer tissues. Instead of finding a healthy white cabbage, a pale-brown rotten mass is seen. It extends in badly diseased trees from the bases of the youngest leaves for a distance of three or four feet downwards until it reaches the harder tissues of the stem. Sometimes it spreads in thinnish lines, which can often be noticed externally by the leaves of one side of the tree turning yellow, while the others are apparently healthy, but at other times it seems to spread centrally and the varying external symptoms must be accounted for by the assumption that the rot has no set method of spreading and, therefore, whatever leaf has its food supplies cut off first must show the first signs of withering and yellowing. A badly diseased bud is generally full of fly larvæ, etc., and the smell is awful. It resembles closely the bud of a tree badly attacked with rot or leaf disease and, therefore, suggests that further researches are greatly needed before any definite conclusion about its origin can be arrived at.

Microscopic examination of the roots and stem indicated that they were quite normal, while those portions of the terminal bud, in the advancing margin of the disease, showed in most cases bacteria of different kinds, but in two instances was the advancing margin marked by a reddish discoloration produced by some fungal mycelium. Although this mycelium has been more or less successfully isolated, fruiting bodies have not been obtained nor have the few infection experiments given positive results. Of the bacteria, two have been isolated in pure cultures, while at least one more has been observed in a rotten bud. Two of the bacteria are apparently gas-producers and have been found in rotten terminal buds of trees that have suffered from the leaf-disease or the root-trouble, while another has only been noticed in rotten buds from the Siparia district.

Whenever the youngest visible leaf is observed to be lopped over and wilting, the terminal bud is sure to be involved in a soft rot. The roots and stem appear to be quite healthy and no evidence of damage to the tree could be found, The few isolated cases in the Cedros district would indicate that this disease is not of a very infections character, but large numbers have been killed out in the Siparia district, the spread being very rapid and apparently from the windward. I am inclined to the view that this disease is similar to the destructive disease of coconuts in Cuba, but as far as Trinidad plantations are at present concerned, it would appear to be largely due to unfavourable conditions of soil, drainage, etc. Weakly trees, whether caused by bad drainage, inferior cultivation or inferior soil, are the most likely to be those that are attacked by disease and therefore improved conditions of cultivation, etc., should render the trees more capable of withstanding attacks.

More prolonged study and much experimental work is necessary to demonstrate conclusively the cause of the disease. With our present knowledge of the nature of the disease it is impossible to suggest a remedy for trees that are already infected, and, therefore, steps must be taken for preventing its spread. The rapidity with which the trees have been killed in the Siparia district and the marked resemblance of this disease to that which has proved such a menace to the coconut industry of Cuba, should illustrate the need for vigorous action being taken in order to prevent further spread of this disease.

MEASURES TO BE ADOPTED.

All diseased trees showing only the "bud-rot" should be cut down and destroyed. If the planter is sure that it is only bud-rot and not root disease (which is characterized by the disorganizaion of the cortex of the roots and by the red dish ring of discoloration in the stem) it should be sufficient to cut off the top 4 or 5 feet from the diseased trees and bury deeply with lime (it would be found impossible to burn such rotten masses as diseased buds). The remainder of the trunk and all rubbish should also be collected and burned or otherwise it may serve to harbour other pests, which eventually may become destructive. Felling and destroying diseased trees is undoubtedly an expensive process, but the neglect of these precautions may make all the difference between a trifling loss of trees and a serious epidemic. It is also necessary that united action should be taken, for it is useless for one planter to care for his estate and destroy all diseased material while his neighbours allow the disease to multiply and their estates to become centres of infection. From observations made in the Siparia district, it would appear that any variety of coconut tree may be attacked, but it would be advisable to look diligently for plants that are resistant to this disease for the selection of the most hardy varieties may be a means of assisting better cultivation, destruction of all diseased material, etc., in dealing with this disease.

Mr. Stockdale's report on "Root-disease," "Leaf-disease," and "Bud-rot" of coconuts concludes with the following:—

SUMMARY AND CONCLUSION.

In conclusion, it has been possible to establish three separate diseases of coconuts in Trinidad, besides those caused by the presence of insect pests. These latter are, at present, doing comparatively little damage

except on one estate in Mayaro district that is suffering from attacks of scale, on another neglected estate in La Brea that was infested with beetles, and another small area in the Icacos district suffering from locusts. The three diseases have been called the "Root-disease," the "Leaf-disease." and the "Bud-rot." The Root-disease is, without doubt, the most serious; it is widely distributed and is causing considerable loss in the Guapo and Cedros districts and in some of the heavy undrained interlands at Mayaro, as well as in smaller areas at Laventille and Cocorite, while it has been reported from Toco and Guaya-guayare. It is apparently caused by a fungus, a species of *Botryodiplodia*, and may be recognised by the yellowing and hanging down of the leaves, by the disorganized condition of the cortex of the roots, by the red ring of discoloration that may be seen in the stem, and by the pustules bearing fungus spores that are invariably seen sooner or later, on the dead petioles. There are reasons for concluding that the disease is primarily one of the roots and although the mycelium of the fungus present in the roots is not continuous through the stem with that in the petioles, experiments tend to indicate that they are of a similar nature, and, therefore, the petiole trouble, though secondary in destruction, may be one of the primary means of distribution of the disease, may spread through the soil by means of mycelium, by spores blown by the wind from tree to tree and by means of the fall of diseased petioles, while replanting of supplies on diseased spots without proper cultivation and treatment may be a means of continuing the disease in the next crop of trees. The disease appears in all soils, but apparently spreads the more rapidly and is the more destructive in damp, low-lying, undrained hollows. Careful attention to drainage, cultivation and application of manures should increase the vigour of the trees and render them less susceptible to attack of disease. Undrained, uncultivated, neglected portions of any estate are a standing menace to the whole estate and perhaps the whole district. To prevent further spread of the disease, the following remedial measures have been suggested :— (*a*) All dead or dying trees, diseased leaves and petioles that have fallen to the ground, rubbish, etc., should be destroyed either by fire or by burying deeply with lime. All stumps should be grubbed up and as many diseased roots as possible destroyed. (*b*) When small areas are noticed, they may be isolated from the remainder of the estate by digging a good trench around them. This should prevent spread of mycelium in the soil to other portions of the estate. (*c*) Resting and cultivation of infected land that has been cleared and burnt before replanting "supplies." (*d*) Spraying and application of chemicals to destroy spores, and also mycelium in the soil. (*e*) Replanting should be done with ripe nuts from disease-resistant trees if such can be found.

THE LEAF DISEASE is limited to small areas, which are apparently in want of better cultivation, and seeing that a similar disease has caused considerable damage to coconuts, especially to young plants, in Java, it is worthy of consideration and should be carefully looked for. It is caused by a fungus—a species of *Pestalozzia* and may be recognised by the yellowish spots on the leaflets especially near their tips. These spots gradually increase in size, the distal leaflets of the leaf turn yellow, then brown, and eventually die. When the leaflets for the terminal 2 or 3 feet of the leaf have died, this portion breaks off and hangs vertically downwards from the end of a dying leaf. (This is characteristic of the disease and is probably due to the weight of the dead tip causing it to break off). The spots on the leaves become a greyish colour and bear on their upper surfaces the spores of the fungus. These spores are capable of distribution by wind or rain and are capable of infecting another leaf directly, provided that sufficient moisture and air be present. They send small tubes into the tissues of the leaves, which destroy them and eventually cause the death of small spots. By an attack at a large number of spots, the leaflet is wholly killed out.

The fungus—*Pestalozzia* sp. is frequently but not always accompanied by another fungus *Diplodia epicocis*, the fructifications of which may be observed as small black spots generally along the veins of the leaflets near the mid-rib or on the petioles, but experiments so far indicate that it is either saprophytic or only completes destruction commenced by *Pestalozzia*. More work, however, is necessary in this direction in order to fully establish the connection between the action of these two fungi.

if there be any. Spread of this disease is accomplished by means of wind and rain and, therefore, besides making every effort to keep the coconut trees healthy and vigorous by improved cultural methods, all sources of infection should be removed as they may be the cause of considerable damage during an unfavourable season.

The following remedial measures are recommended:—(*a*) All dead trees should be cut down and, with diseased leaves, &c., should be destroyed, preferably by fire. (*b*). Isolated trees, that show signs of disease, should be marked, carefully watched and all leaves that become attacked cut out and burned. (*c*) All plants in the diseased area should, as a preventative, be sprayed repeatedly with Bordeaux mixture, particular attention being given to the more delicate leaves.

A Bud-rot Disease was noticed in isolated cases in the Cedros district and had apparently caused the death of many palms on a Savannah in the Siparia district. The cause of the trouble is somewhat obscure. The roots and stem of the palms appear to be quite healthy while the bud is involved in a vile soft rot. In one instance a fungus was present in the advancing margin of the disease but, generally, bacteria were the only organisms present. Three kinds of bacteria were noticed and two of them had previously been found in trees that were suffering from other causes. On no occasion could it be established with certainty how the bacteria gain an entrance or whether they are the primary cause of the trouble.

In the Siparia district the spread of the disease was very rapid but it is probable that more careful attention to cultivation, etc., and prompt destruction of all disease material would tend to keep this disease well in hand.

Finally it must be urged that in dealing with the diseases of coconuts, the adoption of remedial measures must be carried out systematically by all interested in coconut cultivation, wherever the disease is present, in order that a check can be put upon its spread, and I am of opinion that every planter of coconuts should be made to carry out such remedial measures that will suit his local conditions—at any rate he should be made to destroy all dead trees on his grounds for, by co-operation of the planters in this matter, it would be possible to check the disease and probably to eradicate it.

AGENTS.

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RUBBER.

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